North Fork Chetco Watershed Analysis

Bureau of Land Management

Coos Bay District

Myrtlewood Resource Area

First Iteration: August 1997

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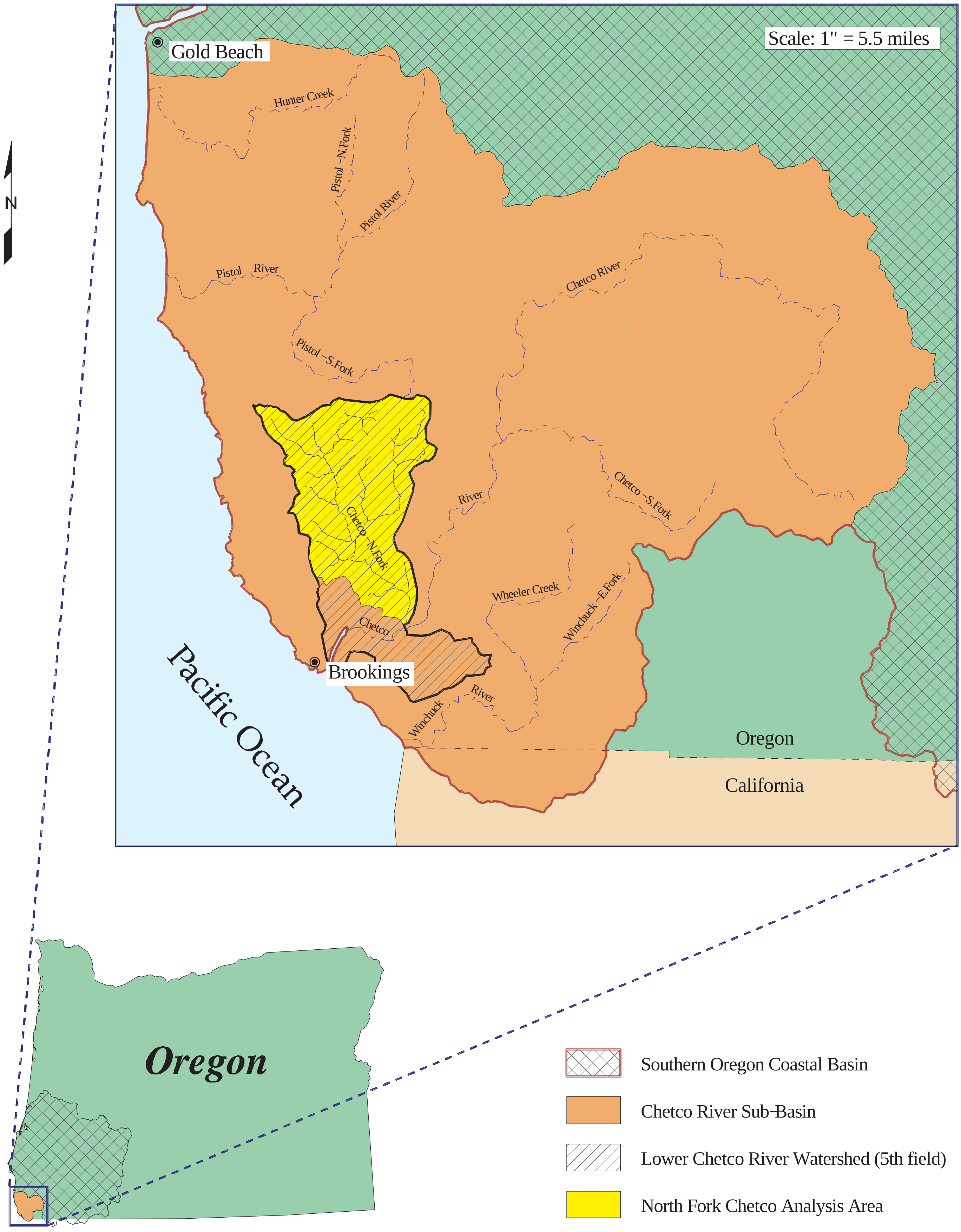
Introduction

This report is the first watershed analysis for the North Fork Chetco subwatershed and is organized within reasonable conformity to the format described in the *Federal Guide for Watershed Analysis Ver. 2.2* (Guide). Prior analysis for this area includes the Chetco River Assessment prepared by the Chetco Watershed Council, March 1995, the Chetco Watershed Analysis (USDA Forest Service, 1996a), and the Guide to Project Selection-South Coast Fish Management District, ODFW 1995. These analyses focused on a general overview of the Chetco drainage.

Watershed analysis is a major component of the ecosystem-based management strategy mapped out in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA/USDI 1994). The stated purpose of watershed analysis is to develop and document a scientifically-based understanding of the ecological structures, functions, processes, and interactions occurring within a watershed, and to identify desired trends, conditions, data gaps, and restoration opportunities. The information, recommendations and data gaps documented in a watershed analysis can be used to help plan land management activities that are appropriate for the analysis area, support the NEPA process, and direct future data collection efforts. Watershed analysis was designed as an iterative process, with reports being revised as additional information becomes available.

Watershed analysis is <u>not</u> a decision making process. Rather it is a stage-setting process. The results of watershed analysis establish the context for subsequent decision making processes, including planning, project development, and regulatory compliance. [from the Introduction to Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. August 1995, Ver. 2.2]

Figure I–1 Watershed Hierarchy of the North Fork Chetco Analysis Area



I WATERSHED OVERVIEW

LOCATION

The North Fork Chetco analysis area is an Regional Ecosystem Office (REO) designated 6th field (subwatershed) within the greater Lower Chetco River 5th field analytical watershed (Figure I-1) and comprises 71% of the 5th field. The analysis area is located about 6 miles north of Brookings, Oregon and is 25,562 acres (40 sq. mi.) in size.

The 56 mile long Chetco River is the largest system in Chetco River sub-basin, draining 351 square miles from the Coast Range and the Kalmiopsis Wilderness Area in the Siskiyou Mountains, westward to the Pacific Ocean. The Lower Chetco River watershed is the most western of three (fifth field) watersheds and has a drainage area of about 56 mi^2. The analysis area comprises 11% of the Chetco River.

OWNERSHIP and LAND USE ALLOCATIONS

Of the 25,562 total acres in the analysis area, the Myrtlewood Resource Area of the Coos Bay District - BLM manages 9,263 acres (36%) with the remaining 25,562 acres (64%) privately owned, predominately by South Coast Lumber Company (Figure I-2).

All BLM lands are designated according to the categories set forth by the Record of Decision for the Coos Bay District Resource Management Plan (RMP) and the Record of Decision (ROD) for the *Supplemental Environmental Impact Statement on Management of Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (SEIS).

Portion of the analysis area has been designated a Key Tier-1 watershed. The Key watershed is 19,429 acres in size and encompasses 76% of the analysis area. The types and amounts of other land use allocation are shown in Table I-1 and their respective locations are shown on Figure I-3.

Table I-1: Ownership and Land Use Allocations in North Fork Chetco Subwatershed

Total Acres	25,562
Private	16,299
BLM	9,263
GFMA (General Forest Management Areas)	7,123
LSR/MMR (late-Successional Reserves)	1,870
Connectivity	270
Riparian Reserves-all land allocations (estimate)	2,944
Total Reserves [1]	5,062

[1] Includes TPCC withdrawn lands, and Riparian Reserves (GFMA only)

Figure I–2 Location Map of the North Fork Chetco Analysis Area

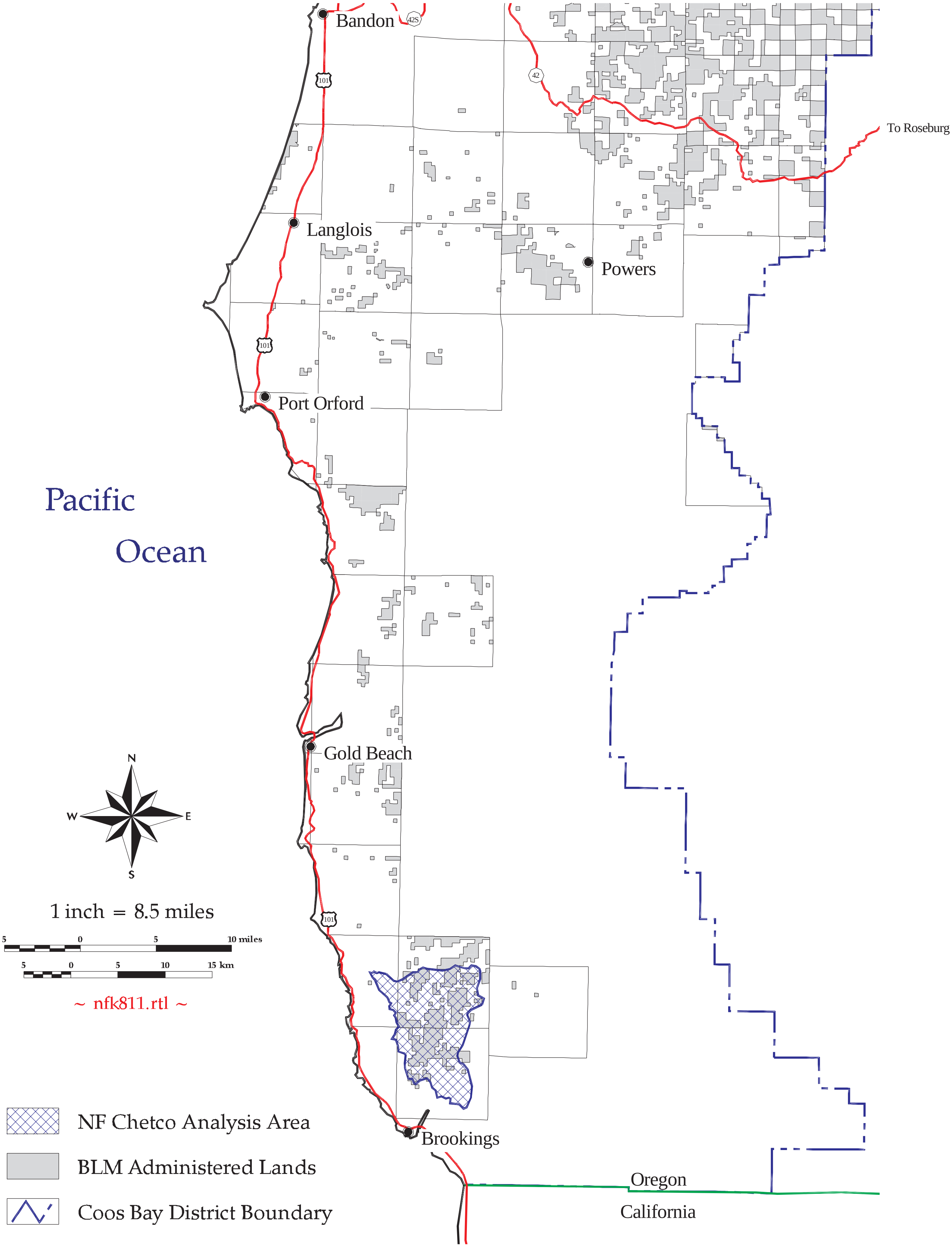
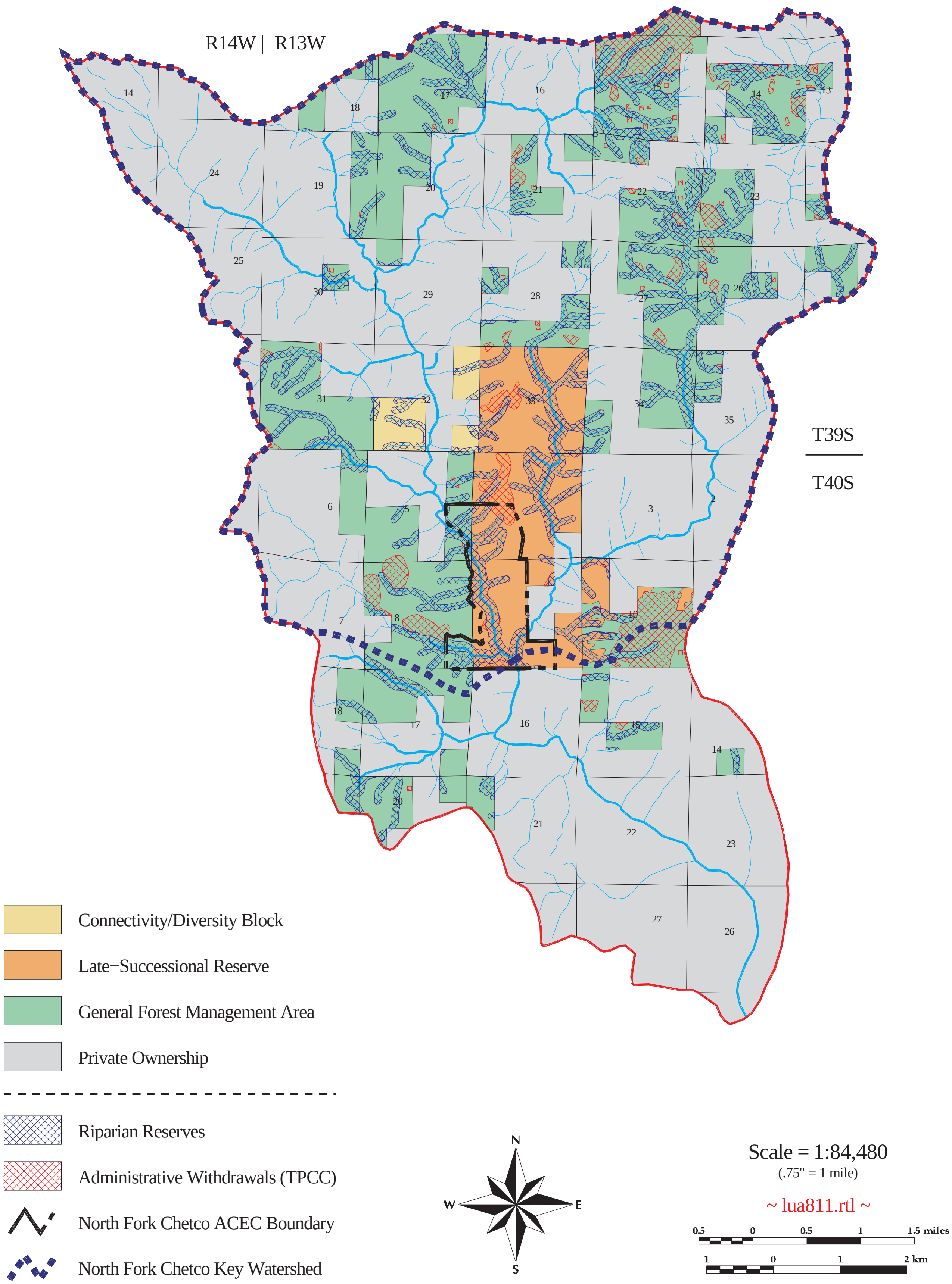


Figure I-3 Land Use Allocations on BLM Administered Lands



PHYSICAL CHARACTERISTICS

The geology , soils, and climate are typical for this part of southwest Oregon. Over 90% of the analysis area lies within the Dothan-Otter Point geologic Formation. Soils have moderate infiltration rates, low water storage, and are a good source of gravels and cobbles. Soil productivity is not considered to be high (site index 3) and compaction of soil surfaces does not readily occur. The climate is very mild, ranging from slightly below freezing to the low 90's, due to the maritime influence of fog and cooler temperatures.

Drainage density is 4.3 miles of stream/mile^2, which is much lower than the 6-8 mi/mi^2 commonly found in drainages further to the north. The distribution of small headwater streams (72%) and larger streams (28%) is comparable to the more northerly subwatersheds. The North Fork Chetco River has a length of 12.7 miles and is a 5th order stream for approximately one-third of its length. Bravo Creek is the largest tributary to the North Fork Chetco and is also a 5th order stream. The other tributaries are short (3½ miles or less), steep streams (Figure I-4).

In contrast to subwatersheds in the Coast Range Physiographic Province, the hillsides are more smooth to convex in shape. That is, the ridge tops are generally more rounded and broad, sloping off steeply as one approaches the stream system. The streams have very steep, unstable sideslope (often 90% or more) and a narrow floodplain, if one exists at all. The most prominent feature is Bosley Butte, which forms part of the northerly boundary and has an elevation of 3400' (Figure I-5).

EROSION PROCESSES

The dominant erosional process is non-channelized shallow rapid debris sliding, which constitutes 84% of the total landslides. Landslide location is most strongly correlated with extremely steep slopes (>90%) adjacent to perennial stream channels.

Management activities (timber harvest and road construction) have led to an increased frequency of all types of landsliding, including stream-side shallow rapid slides, channelized debris torrents, and large persistent landslides. A majority of these slides occurred between 1955 and 1970, coincident with high harvest rates (43% of the analysis area) and significant floods (1955 and 1964). Early timber harvest was usually performed with ground-based equipment and road construction techniques involved side-casting earthen material. A marked decrease in landslides was observed since 1970. The current rate of landsliding is approaching pre-management levels, which may reflect changes in forest management techniques and a long drought period (1985-1994).

Sediment delivery from surface erosion and mass movements has occurred, but no attempt to quantify the actual delivery amount was made. The over-riding hypothesis for this analysis area is that, over a long period of time, all slide material will eventually be delivered to the stream system.

Figure I−4 Hydrologic Units

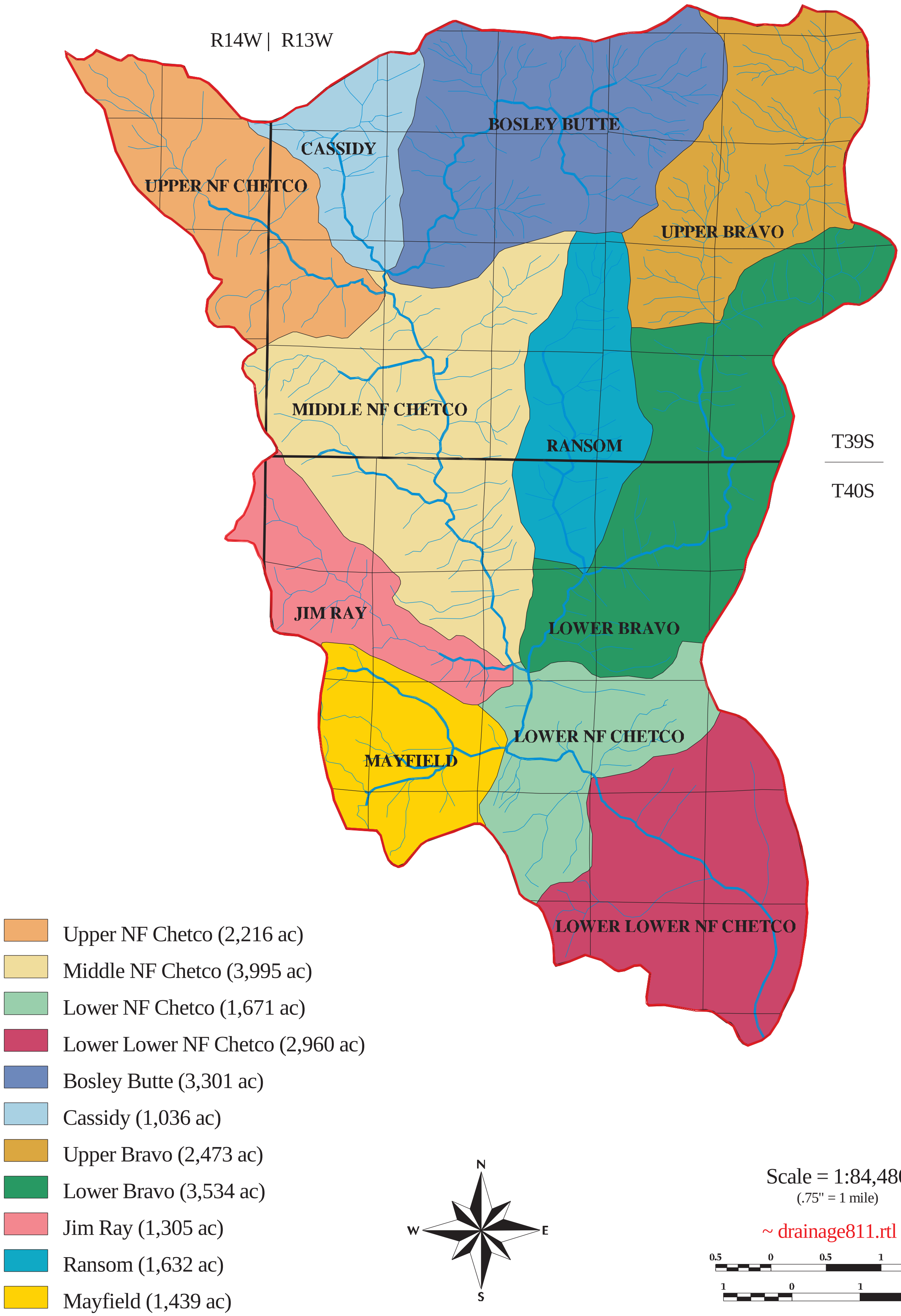
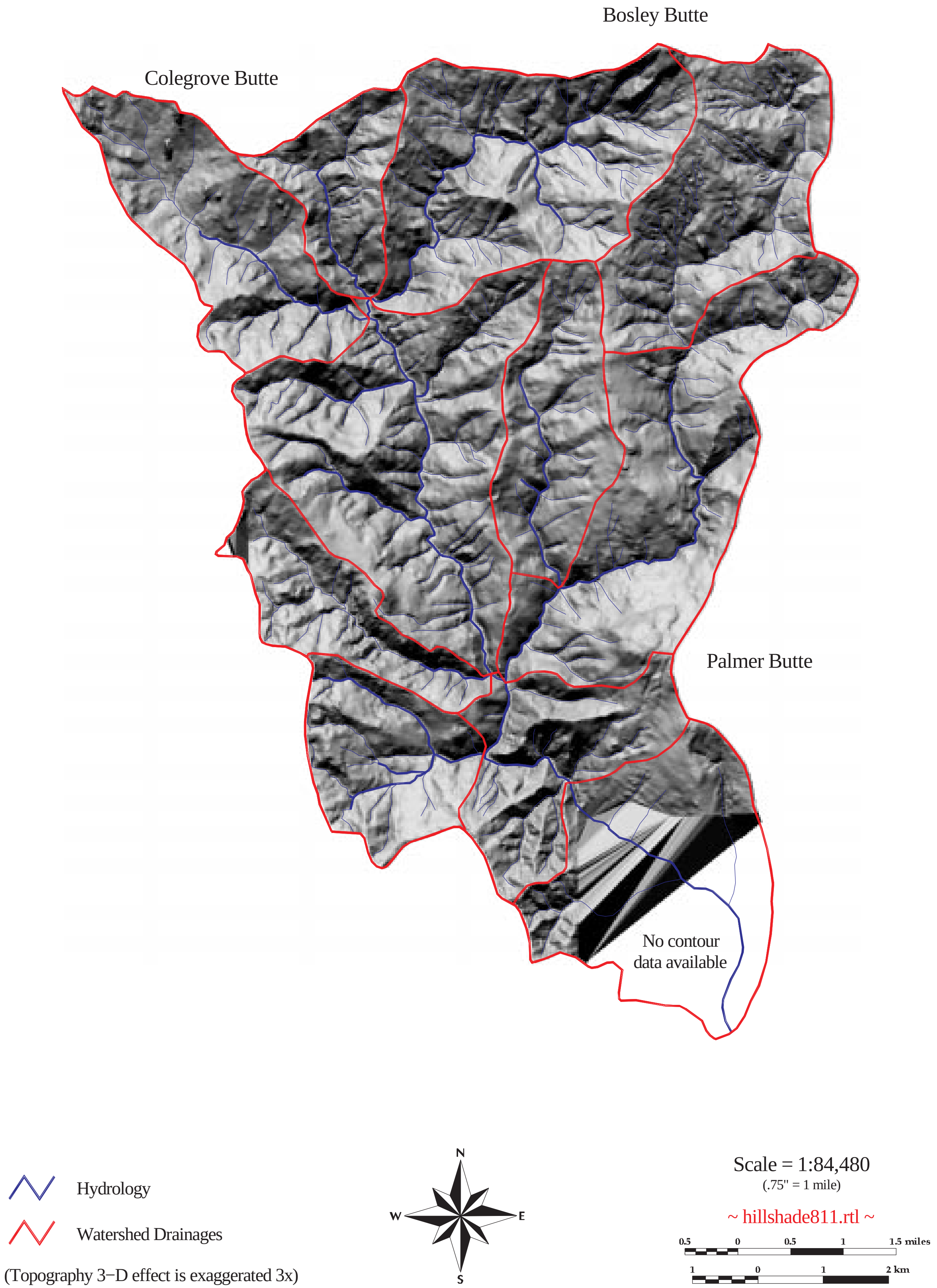


Figure I−5 'Hillshade' Representation of the Topography



The amount of land surface compacted from roads and equipment trails was determined to be 1.7 % of the analysis area. Most of the roads and trails were captured on the data base and are reflected in this figure. The level of compaction from timber harvest was not determined, but is expected to be lower than the level caused by roads. Compaction is only an issue in the upper elevations (snow zone) of the analysis area when it concentrates flows, thereby increasing erosion on poorly maintained road surfaces.

HYDROLOGIC PROCESSES

Stream flow patterns correspond to seasonal rainfall patterns. Stream flow responds quickly to precipitation events, with tributary streams having sharp increases in flow within just a few hours. Many soils are shallow to moderate depths and transmit water readily. Bedrock has low water transmissivity. Peak flows of record occurred in 1964 (15,235 cfs for the analysis area) and 1996 (13,165 cfs). Extreme flows (>2500 cfs) occur less than 5% of the time, moderate bankfull flows (100-2500 cfs) occur 55% of the time, and low flows (<100 cfs) occur 40% of the time. Low summer flows for North Fork Chetco are often less than 10 cfs (0.25 cfs/mi^{2} for 2 year-7 day low flow). These low flows are the result of dry summer conditions, combined with few landform characteristics, including lack of floodplains, that accumulate runoff and release summer flow. About 38% of the forest vegetation is currently under 40 years or age, and may not be hydrologically recovered. However, most of the analysis area is in the rain zone and is not susceptible to significant flow changes, or departures form natural conditions.

Overland flow, resulting in sheet erosion and formation of rills and gullies, can occur in the higher elevations of the analysis area. Within the higher elevation, the areas most susceptible are compacted areas, areas burned with intense fires, or that within the transient snow zone. Most of the gullies are discontinuous, although some have connected with the stream system. Road ditches have also extended the stream network, although not significantly.

The transient snow zone (elevations above 2000 feet) is found in 5% of the analysis area and is confined to the Upper Bravo Creek and Bosley Creek areas. Snowpack (representing water storage) and warm windy and rainy conditions in open areas or young timber stands may elevate peakflow in these tributary streams. However, the set of climatic conditions needed to initiate this type of event is infrequent.

Many stream channels are high energy, erosional, streams with moderate to steep gradients. Bedrock, boulder and cobble materials form stable channels with resistant streambed and banks. These channels are excellent in resisting degradation, both laterally and vertically from flashly, high flows.

Sediment delivered to the channels from landslides or torrents is routed through the stream system and does not appear to inundate channels with chronic levels. Few floodplains exist for water to spread, due to the steep canyon land formation, forcing streamflow velocities to remain high. Consequently, stream power is available to transport this bedload during storms, making these channels very resilient to inputs of sediment. Much of this sediment was introduced to channels during the 1950's to 1970's, coinciding with high levels of road building and forest management and the 1955 and 1964 floods. Channel aggradation by coarse sediment (gravel and larger) may have occurred during this period. Today, sediment delivered to channels appears to be approaching that of pre-management levels and channel aggradation is not evident. Much of the material is suspected to have been exported from the stream system.

DISTURBANCE PROCESSES

Fire is the primary natural disturbance process in this part of southern Oregon, including the analysis area. Historical fires were generally large in size and thought to be of low to moderate intensity. In contrast, recent fires caused by human activity tended to be more intense, resembling stand replacement fires. Fires of varying intensities produced vegetation patterns which are still evident within the analysis area. The last major fire burned in 1939. Presently, the most common form of large-scale disturbance is forest management.

Landslides appear to be the common form of disturbance in riparian areas. These play a major role in delivering components (boulders, gravels, large wood, etc.,) into the stream system. They also are a significant factor in maintaining pioneer tree species, such as red alder and Douglas-fir along riparian areas.

Wind has played a very limited role as a disturbance factor in the analysis area.

WATER QUALITY

North Fork Chetco and Bravo Creek are listed on ODEQ's 303(d) list of water quality limited streams with regard to temperature during the summer. Streams are listed on the 303(d) list when monitoring data indicates stream reaches do not meet State water quality standards.

Suspended sediments, as measured by turbidity, does not appear to be a problem for streams in the analysis area. Water clarity is good (less than 1 NTU), except during storms, where turbidities may exceed 200 NTU. Most stream sediment delivery is the result of landsliding and debris torrents, with lessor amount from road ditches and gullies. Although natural surfaced roads constitute 82% of the road system, the process of surface erosion from roads appears to be different than in subwatersheds to the north. Soils in this area contain a high rock content and, after the first few years following construction, have the effect of amouring the road and ditch surfaces from continual surface erosion. Gullying is often the result of inadequate drainage or the lack of road maintenance.

In addition, embeddedness of fine sediments in stream gravels does not appear to be a problem in the analysis area. High stream velocities during bankfull or larger storms, rapidly transport coarse and fine sediments through the stream system.

VEGETATION

The analysis area lies within the Mixed-Evergreen (*Pseudostuga*-Sclerophyll) forest zone (Franklin and Dyrness 1973). Douglas-fir and tanoak dominate forest stands, covering over 85% of the analysis area. Pure stands of knobcone pine are also present and the tend to be areas of recent fires. The largest stand is concentrated in the Bosley Butte area, with small pockets scattered along ridgetops elsewhere. Small acreages of grass-bald type meadows are distributed throughout the area. These meadows, which once numbered approximately 1000 acres, are disappearing due to encroaching vegetation.

There are approximately 230 vascular plant species representing 70 plant families documented or likely to occur within the analysis area. Bryophytes, lichens, and fungi represent a large percentage of the vegetative diversity. Many of these species, have important ecological roles (such as nutrient cycling, soil stabilization, water retention, etc.) in forested ecosystems while having specific habitat requirements. Species numbers are unknown, but it is estimated that over 500 species probably occur in the analysis area, at least 29 of which are of special management concern and require further site-specific analysis under the regional planning efforts .

Unharvested riparian areas adjacent to many small first- and second-order streams, as well as mainstem reaches, contain relatively high densities of large conifer trees compared to many upslope areas in the analysis area. These trees are available for snag and down log recruitment. Western hemlock, western redcedar, and Port-Orford-cedar are absent along the larger streams, but are present in a few locations on the western edge of the analysis area. The primary overstory species in unlogged riparian areas is Douglas-fir with bigleaf maple, tanoak, and Oregon myrtle (California laurel) co-dominate the middle and understory. Red alder is generally found in a narrow band immediately adjacent to streams and on disturbed (logging, flooding or landslide) sites. Previously harvested areas in main-stem reaches contain a mix of hardwoods in the overstory (red alder, bigleaf maple, tanoak, and Oregon myrtle), with no large conifers. In general, cover of salal and tanoak tends to increase as soil moisture decreases toward the headwaters.

Port-Orford Cedar

Port-Orford Cedar is virtually non-existent in the analysis area and, therefore, the threat of spreading Port-Orford Cedar root rot disease into or out from the area is not a management concern.

Noxious Weeds

There are only a few isolated known locations of noxious weeds (gorse & broom) in the analysis area and the potential for introduction of noxious weeds exists. However, the opportunity for effective control appears good, due to the few number of infected sites and restricted access into the area.

SPECIES AND HABITATS

Terrestrial

Key habitats in the analysis area include *vegetation complexity and species composition, snags and down logs, and rocky habitats.* The majority of the area (83%) supports early seral habitat, most of which is the result of timber harvest. Compared to other subwatershed in the Resource Area, the analysis area contains larger blocks of relatively unmanaged stands. Fifteen percent of the analysis area supports a combination of mid and late-successional forest patches and is found almost exclusively on BLM administered lands. Many of these late-successional forests are along streams. Late-successional habitats comprise approximately 39% of the LSR (#251). The objective of retaining 15% of the federal land base in transition or old-growth habitat types can be met on Reserve lands.

Sixty one percent of the analysis area has been harvested and likely contains few if any down log and snag structures. Snag density goals equate to approximately 1.5 hard snags/acre, (4 hard snags/acre on Reserve lands). Critical snag shortages are likely in the near future unless additional snags are created through management. Minimum down log retention levels for hard down logs from the RMP equate to approximately 18-95% of that found in natural stands.

Since the analysis area is only 2-9 miles inland and on the edge of the main forest network on Forest Service land, it does not function as a critical dispersal area for mobile, late-seral wildlife. Its proximity to the ocean does hold unique function for those species, such as marbled murrelets, which use both inland and ocean habitats. Its function and significance are more local in scale in providing special habitat areas and populations of species on the western edge of their range.

Species of concern in the analysis area include amphibians, bats, raptors, voles, and snakes. Del Norte salamanders, red tree voles (S&M species); peregrine falcons, northern spotted owls, marbled murrelets (T&E species); and bats (special management guides) are known or very likely to occur and will require special consideration in management. Pre-project surveys for red tree voles are not required since habitat conditions are above thresholds established by draft protocol.

Aquatic and Riparian

The North Fork Chetco analysis area contains approximately 14 miles of anadromous and resident fish-bearing streams with an additional 18 miles containing only resident fish. Total miles of anadromous fish distribution may vary yearly based on habitat and flow conditions. Native fish species include fall chinook salmon, coho salmon, winter steelhead, anadromous and resident cutthroat trout, and Pacific lamprey. The analysis area falls within the range of the Threatened Oregon coast coho salmon (southern Oregon/northern California ESU) and the Proposed Klamath Mountain steelhead. Resident rainbow trout are present in Bravo Creek, and cutthroat/rainbow hybrids are suspected elsewhere, apparently the result of residualized steelhead fry. The North Fork supports relatively high spawning populations of steelhead and chinook salmon, with a large proportion (up to 50%) of hatchery origin.

For anadromous and resident fish, access to spawning and rearing habitat in the analysis area primarily limited by *natural* barriers or habitat conditions (high gradients or cascade/falls). In some streams, numerous passable obstacles cumulatively restrict the upstream distribution of fish. The only known human-caused barrier to fish migration is a culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16). Although resident cutthroat trout were observed upstream of the culvert, it is a barrier to upstream movement.

Salmonid rearing potential in the analysis area is limited by high summer water temperatures, high winter flow and velocity, low summer flow, hillslope constraints, a shortage of floodplains, lack of large wood, and lack of deep complex pool habitat.

Several species of amphibians use streams for all or part of their life cycle. Amphibians, crustaceans and hundreds of other invertebrate species make up most of the biomass in streams and are the functional building blocks of the aquatic ecosystem. In addition to providing the major food source which sustains stream fishes, the invertebrates contribute to the maintenance of aquatic and riparian food webs by processing vegetation and leaf litter, increasing the availability of nutrients to other organisms (Christensen 1996, Taylor 1996).

HUMAN USES

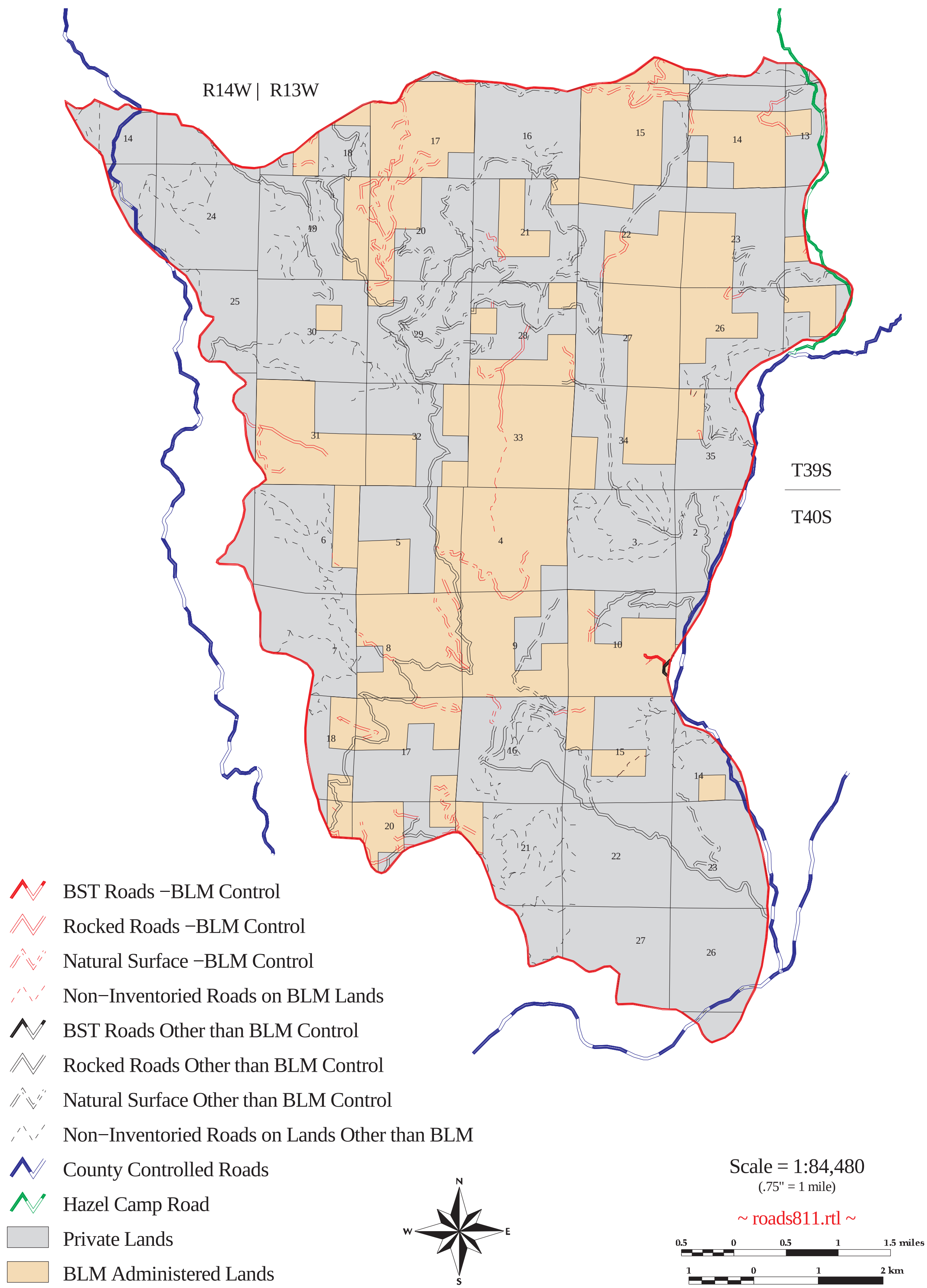
The North Fork Chetco area has been the location of both prehistoric and historic cultural activities. Its proximity to the coast and the mainstem Chetco River offered good foraging and hunting opportunities. The present focus of human development tends to concentrated along the east and west ridges bordering the analysis area. Residences and agricultural uses are located adjacent to the Gardiner Ridge County Road (on the east) and Old Highway 101(on the west). Within the analysis area, timber production is the predominant use of the land. No dispersed recreation (other than deer hunting) occurs within the interior of the analysis area, as access into the area is controlled by South Coast Lumber Company

Transportation

The analysis area is bordered on the east, west, and south by County roads (Figure I-6). Hazel Camp Road, on the east, accesses the Siskiyou National Forest. The road system is somewhat similar to others throughout Western Oregon in that the early roads used to access the area were constructed along main streams. Three of these roads are presently being used as main access roads. In contrast with most other subwatersheds, most main roads currently used to access this area are of ridgetop and sometimes midslope location. The private road system forms the backbone of the transportation system in this analysis area.

The transportation system in the analysis area is comprised of approximately 145 miles of road, which equates to road density of 3.6 mi/mi^2. The road density on BLM lands is substantially less at 2.3 mi/mi^2. BLM controls 28 miles of road (20% of the total) and these are often short spur roads used to access BLM ownership. Approximately 82% of the road system is natural surfaced (25 miles of BLM and 94 miles of private road). The remaining system including the mainline access roads is predominately gravel surfaced. These figures (Appendix F, Table F-1) have been derived from GIS. While some data is missing, primarily on private lands, it does give the most up-to-date information available.

Figure I-6 Transportation Theme by Control and Surface Type



Transportation Management Objectives
The BLM road system was evaluated for its present and future uses using a Transportation Management Objective (TMO) process. The TMO process applies only to roads controlled by the BLM, as management of those roads lies within the Bureau's jurisdiction. Road management is guided by the desire to reduce the impacts from a large road network on the ecosystem, maintain a network adequate enough to meet the needs of land management, and to reduce road maintenance expenditures. The checkerboard land ownership pattern significantly complicates transportation management due to the right of access for landowners and the fact that different landowners often own alternating parts of the same road. BLM has constructed roads on private lands through a variety of access agreements and private timber companies have constructed roads on BLM lands under 'reciprocal' right-of-way agreements. These agreements grant access rights to the BLM and the other party to cross each other's land. These rights must be incorporated into any decision concerning road management. In addition, roads adjacent to streams and midslope roads, which often have the most impact of the aquatic resources, are often the main access roads into and through the analysis area. Most of the roads which present the best opportunity for closure or restricted vehicular access are the shorter, mostly ridge-top roads which access only BLM lands.

The 1995 Rescission Bill authorized two 1991 timber sales within the Key Watershed and resulted in the construction of 2.8 miles of permanent road. These roads were located predominately on ridge-tops and contained only two stream crossings. The ROD Standards & Guidelines and the Biological Opinion concerning the Southern Evolutionarily Significant Unit of Coho Salmon require that there be no net gain of road miles within Key Watersheds. The TMO process identified 5.5 miles of road which could be removed from the transportation system.

Rock Quarries
There is one small rock quarry operated by South Coast Lumber Company located adjacent to Jim Ray Creek (NW¼ SW¼ Sec. 8, T. 40 S., R. 13 W.). Areas quarried to produce rock for specific road construction projects exist throughout the analysis area. These sites, such as Colebrook Butte, would normally be small and located where a road intersects hardened rock material.

II ISSUES AND KEY QUESTIONS

ISSUES
Two main issues have initiated the need for, and the focus of, this watershed analysis in the North Fork Chetco area.

- Two 1991 timber sales, authorized by the 1995 Rescissions Bill, may not be in compliance with the NFP and RMP for management activities within Key Watersheds or with the recent Biological Opinion concerning the Southern Evolutionary Significant Unit of Coho Salmon.

- Resource conditions need to be evaluated in order to identify restoration opportunities, which could be implemented through the 'Jobs-in-the-Woods' program or other funding opportunities.

This document is NOT intended to identify potential timber harvest areas within the Matrix land use designation, other than hardwood conversion opportunities. Another iteration of WA needs to should completed to address this management activity.

Resource concerns identified in this analysis will be further analyzed on a site-specific level in future environmental assessment (NEPA) documents.

KEY QUESTIONS
The Guide recommends development of ‘key questions’ which address the main issues, focus on ecosystem elements as they relate to management actions, promote synthesis/interpretation of information, and are to be answered by the analysis. They are:

1. What immediate mitigation and restoration opportunities exist to comply with the recent Biological Opinion as a result of the two 1995 Rescissions Bill timber sales?
2. What is the current condition of the Late-Successional Reserve (#251) and what restoration opportunities exist to mitigate the impact of the two 1995 Rescissions Bill timber sales?
3. What opportunities and needs for restoration exist in the analysis area for aquatic and terrestrial habitats to improve water quality, aquatic habitat, vegetative communities, or wildlife habitat?
4. What management activities are appropriate within the Key Watershed and Riparian Reserves?

ANALYSIS QUESTIONS
Each section contains a series of analysis questions. These were developed by the team and are designed to become progressively more refined in order to answer the key questions. The Guide also contains a series of so called ‘core questions’ to be addressed. Answers to these core questions are contained within the team’s analysis questions or were not found to be relevant to this analysis.

III PHYSICAL CHARACTERISTICS

III.1 GEOLOGY

The North Fork Chetco analysis area is comprised of formations characteristic of the Coast Range Physiographic and Klamath Mountain Physiographic Provinces (Figure III-1).
The Dothan - Otter Point Formations (Jdo, Jv) are the primary rock units within the Coast Ranges Province. Both are of the same age and somewhat similar lithologies. They consist of a fractured to highly sheared sequence of graywacke-mudstone with subordinate chert, andesitic and keratophyric breccia, pillow basalt, minor conglomerate, and occasional limestone lenses in the graywacke-mudstone. This formation covers over 90% of the analysis area with the remaining comprised of Tertiary intrusive rocks (Ti). A number of dacitic and rhyolitic dikes and sills intrude the Dothan Formation (State of Oregon, 1977).

III.2 SOILS

According to digitized data obtained from the Soil Survey of Curry County, OR. (in publication), there are twenty seven (27) different soil types on differing slope classes in the analysis area (Figure III-2). At this time, the data does not allow for these soil types to be categorized or interpreted other than through a limited database of physical characteristics. No groupings of soil types by similar properties have been constructed. Subsequent analysis may provide data to allow computer modeling of surface erosion and landslide vulnerability.

Review of data shows several trends within the analysis area. There is a pattern where many ridges have deep soils with clay subsoils, rather than shallow rocky soils. These cap soils have low permeabilities, hold water for longer periods of time, and may provide water to the stream channels below. Where soil types change on sideslopes, becoming shallower, water may be forced to the surface just below these perched ridge water tables. This process sustains perennial flow higher upslope than normally expected.

An assessment of the analysis area for slope hazard is displayed in Figure III-3. The majority of the analysis area has moderate slopes less than 60% and a few areas of steeper 60-90% slopes. Unstable areas are those slopes greater than 91% and are found most often adjacent to the stream channel up to the first inner gorge. These areas are most often associated with the lower portions of the main streams, but are also a feature on the upslope areas in first and second order channels.

The Timber Productivity Capability Classification (TPCC) rates the ability of the land to produce a given amount of timber from the landscape. The areas given protection due to fragile gradient (ie., commonly used as an index of instability) are largely located in the stream channel margins of the Bosley, Lower Bravo, Middle NFC, and Ransom Creek drainages (Fig. III-4). The majority of the land withdrawn from commercial timber harvest is due to low moisture and low site potential. Using the slope hazard map to determine the inoperable areas would be a better guide for management activities.

Figure III−1 Geological Formations and Fault Lines

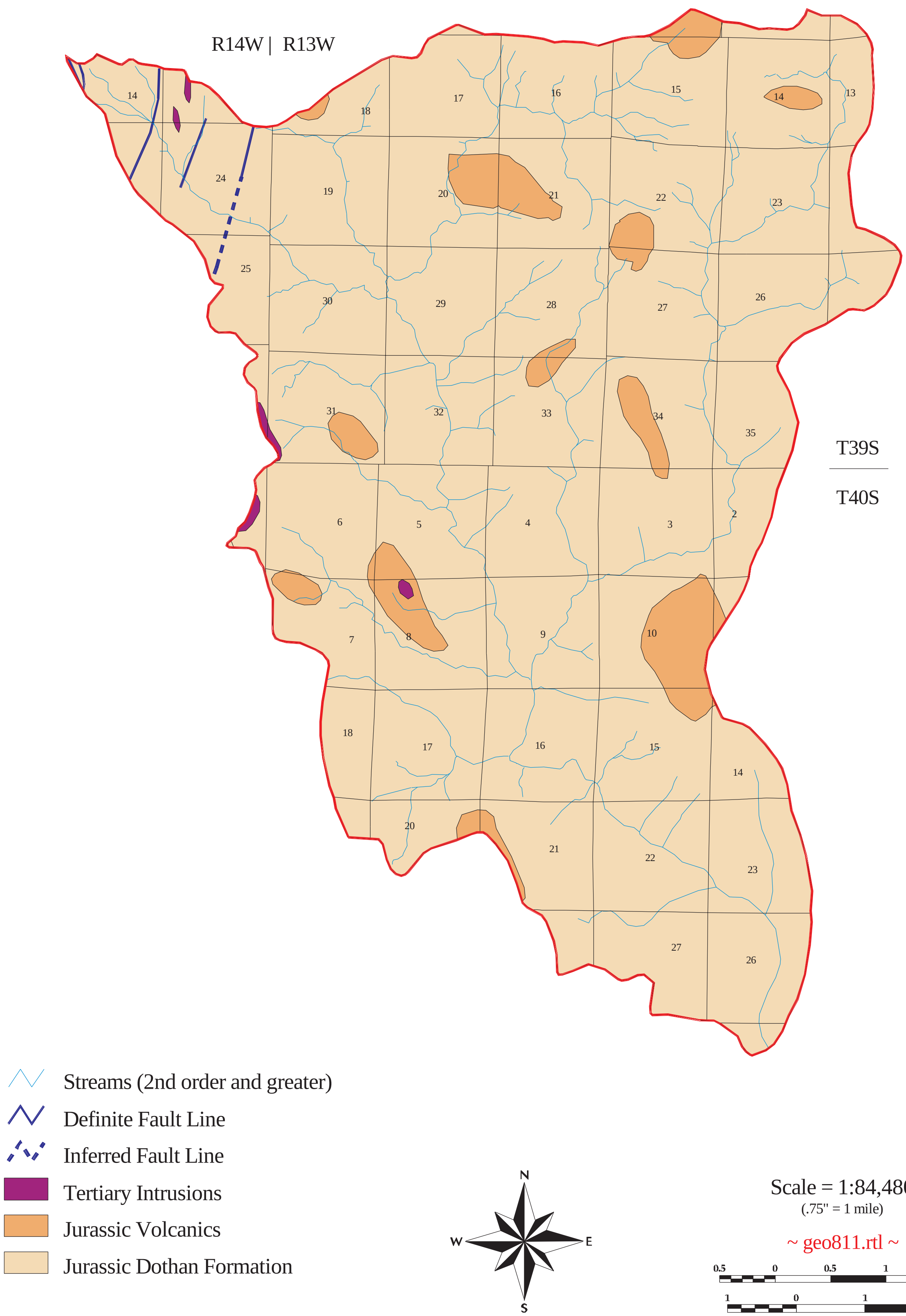


Figure III−2 Soil Types

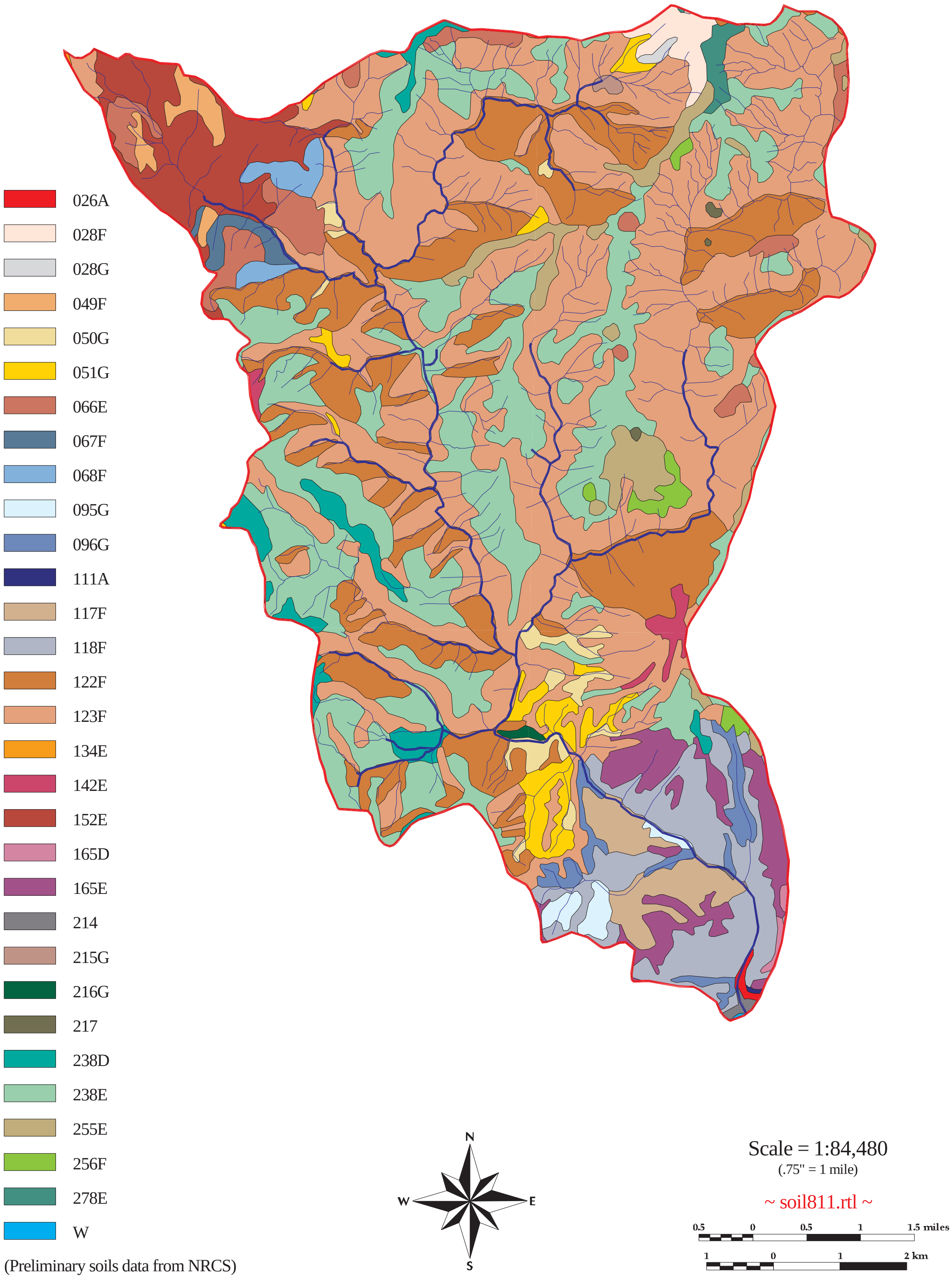
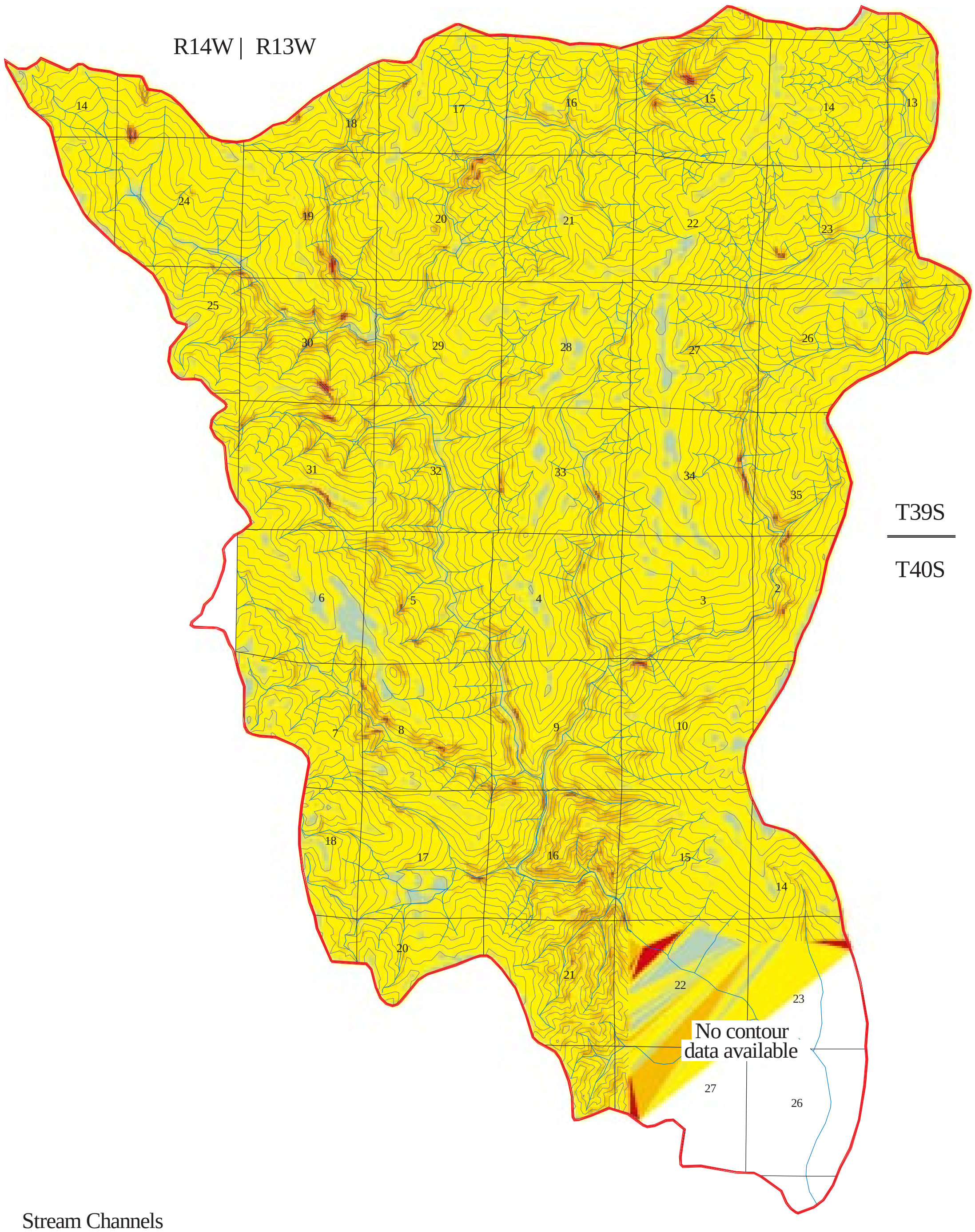


Figure III-3 Slope Hazard Classes



Stream Channels

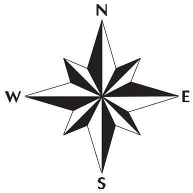
100' Contours

Gentle Slopes – 0% to 12%

Moderate Slopes – 13% to 60%

Steep Slopes – 61% to 90%

Extremely Steep Slopes – 91% +



Scale = 1:84,480
(.75" = 1 mile)

~ hazard811.rtl ~

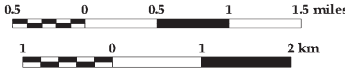
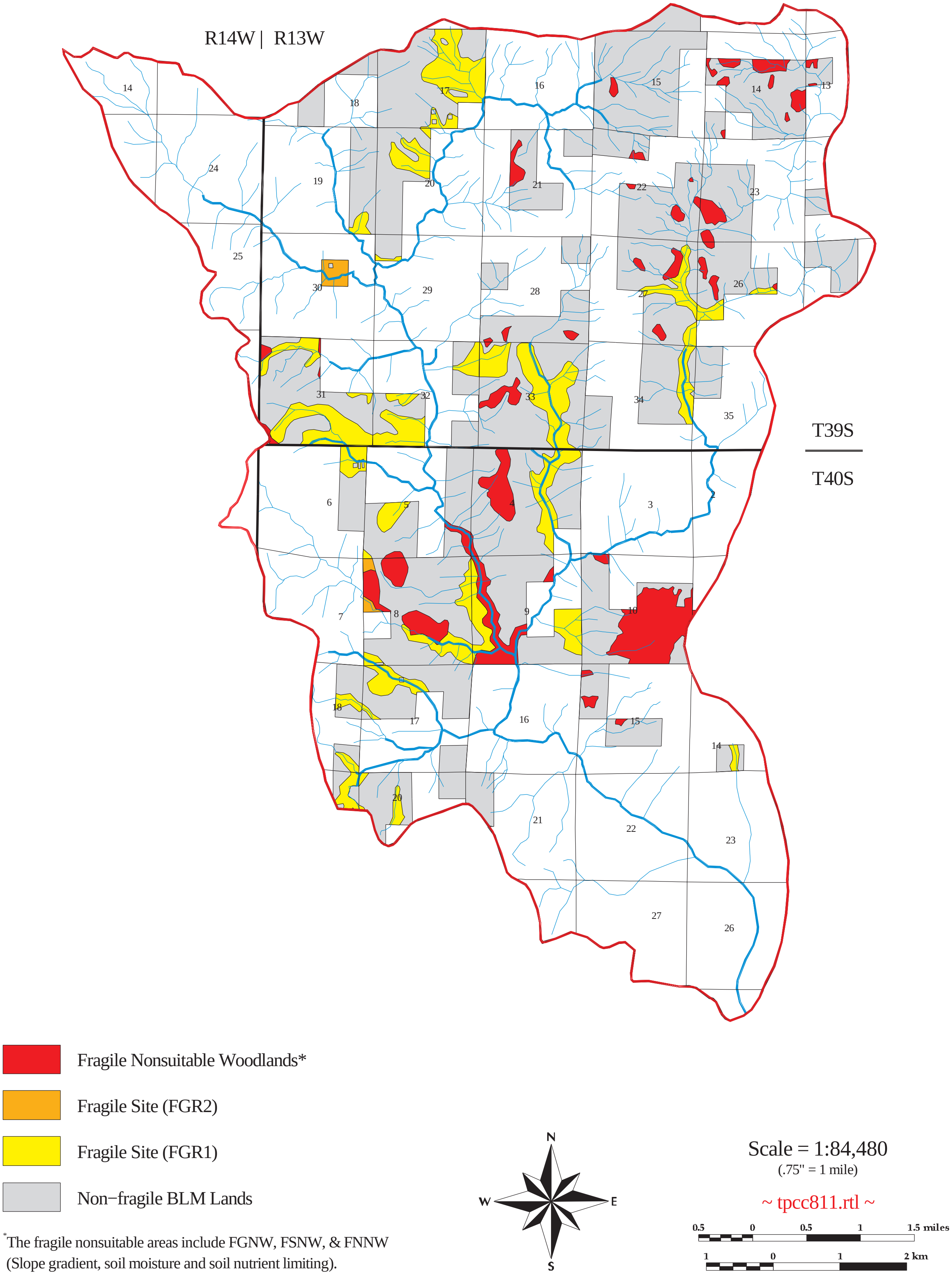


Figure III−4 TPCC Fragile and Withdrawn Areas



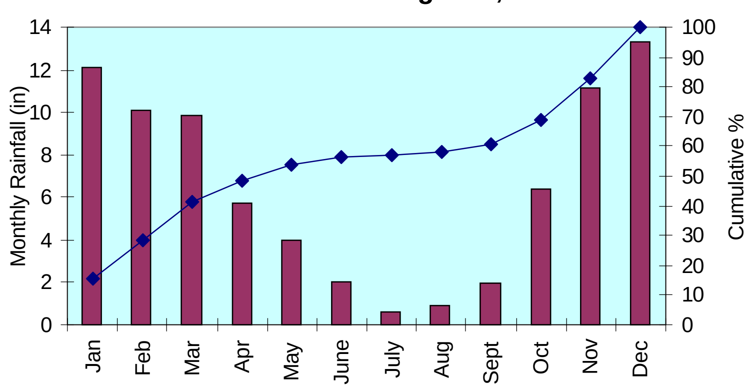
*The fragile nonsuitable areas include FGNW, FSNW, & FNNW (Slope gradient, soil moisture and soil nutrient limiting).

III.3 CLIMATE

Annual precipitation occurs mostly as rainfall varying strongly with elevation, with greater amounts in the higher portions of the analysis area. Precipitation ranges from 100 inches in the low elevations and river valleys along the North Fork Chetco, to more than 140 inches in the upper areas near 3400 feet (OSU 1993). Aspect and drainage orientation to prevailing winter Southwest winds also influence precipitation amounts. Cool, moist air masses lifting over the Coast Range can produce snow over 2000' elevations. These are intermittent snow packs, which usually persist on the ground for only a few weeks and sometimes melt quickly with warm winds and rain. This extra water storage as snow water equivalent can elevate flood waters.

Approximately 90% of the average annual precipitation occurs between October and April, with 50% occurring during November-January (Figure III-5). Although heavy rainfall occurs with winter storms, much of the precipitation is low intensity. Precipitation during the May through September summer months is only about 10% of the annual average, the dry season precipitation being 10-14 inches (OSU 1982).

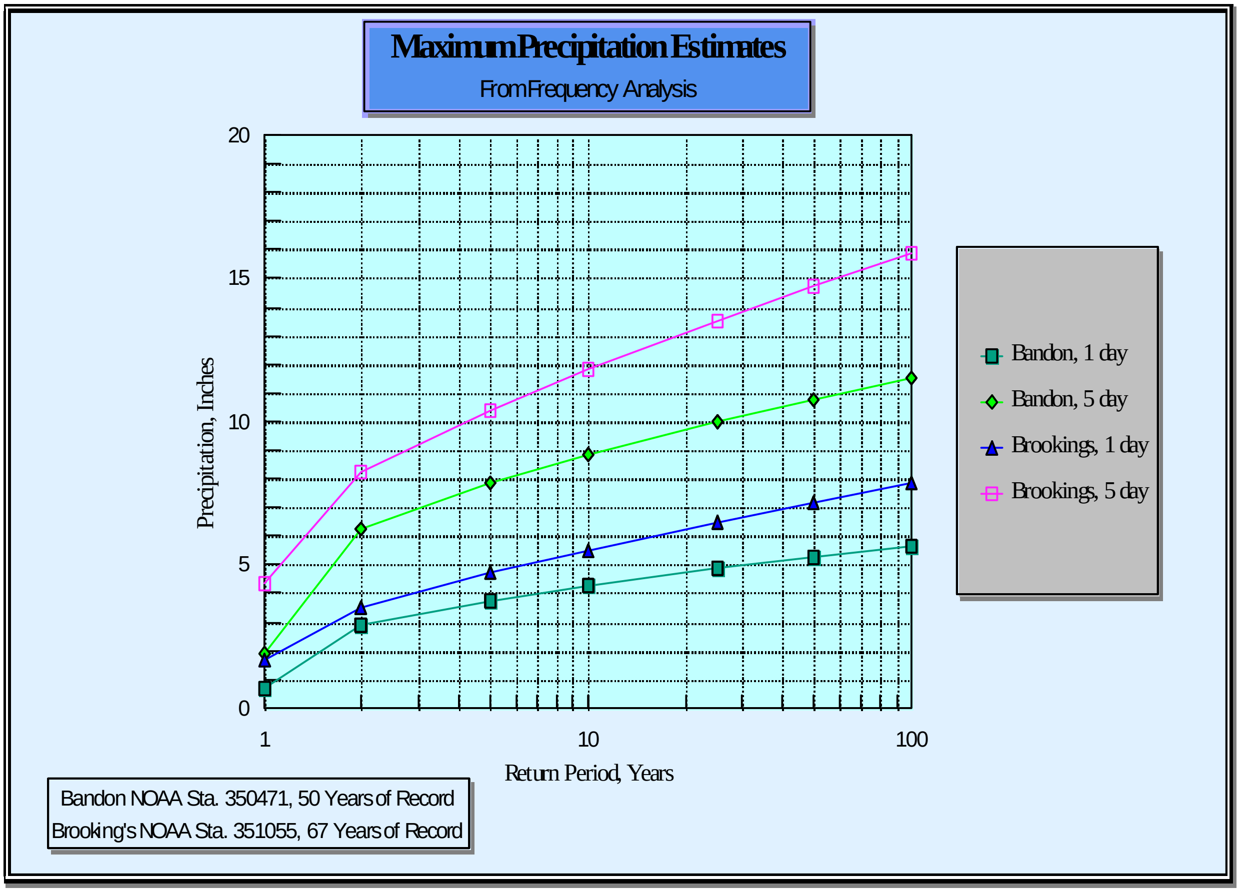
Figure III-5 National Weather Service Data for Brookings OR, 1931-1997



The periods of maximum precipitation are responsible for high runoff, including flooding, watershed erosion, slides, and debris torrents. However, this occurs on an infrequent basis. High precipitation combined with the melt of existing shallow snow packs can worsen flooding. Frequency analysis from the Brooking's NOAA Cooperative Weather Station indicates that a cumulative 5 day-5 year recurrence interval storm could be expected to have precipitation of at least eleven inches (Figure III-6). Actual rainfall depths for the analysis area are higher for a given return period than shown in Figure III-6. This is because precipitation intensity is highly correlated with elevation along the Oregon Coast and the mean elevation is about 1500' higher than the Brooking's NOAA weather station. A higher incidence of landslides and torrents has been correlated with storms which totaled 11" or more in several days (refer to Section III.5-Erosion Processes).

Temperatures are generally quite mild with maximum temperatures seldom exceeding the low 90's, nor falling much below freezing.

Figure III-6 Maximum Precipitation Estimates



III.4 WATERSHED GEOMORPHOLOGY

The North Fork Chetco analysis area is a minor component of the Chetco River Basin, comprising 11% (25,563 acres or 39.94 mi^2) of the Basin and forms the lower elevation portion. Streams in the analysis area are oriented north-south. Elevations are lowest along the southern boundary (100') and highest along the northeastern edge near Bosley Butte (3400'). Drainages are situated north-south to east-west and vary from 1300 to 4000 acres. Drainages have broad ridgetops, smooth to convex sideslopes that are punctuated with moderate stream dissection. Valley bottoms are very narrow with many inner gorge steep hillslope and cliff features. The valley width index is often 1.0, which means that the valley bottom width equals the active stream width. Floodplains are essentially absent, except for the lower mainstem and isolated reaches along tributary streams. The majority of observed landsliding is concentrated near streams along inner gorges and steep toeslopes (refer to Section III-5- Erosion Processes).

The North Fork Chetco has a length of 12.7 miles and has its confluence with the Chetco River near rivermile 5.1. The drainage pattern is dendritic with a drainage density of 4.3 mi/mi^2., which is among the lowest observed in the Coast Range. About 124 miles of streams are found of which first and second order streams comprise 72% of the total drainage density (Table III-1). These are generally moderately steep headwaters channels draining small catchments. It is estimated that approximately half of the first order streams (46 miles) become intermittent by late summer. This figure is based on modeling and the actual miles of intermittent streams is judged to be slightly higher (refer to Section VI-Riparian Reserve Evaluation). Most of the remaining 126 miles (71%) of streams are perennial.

Table III-1 Miles of Stream by Stream Order for the North Fork Chetco Analysis Area.

Drainage	Miles of Stream by Stream Order [1]					
	1	2	3	4	5	Total
Lower Lower North Fork Chetco	1.3	1.3	2.7	-	3.3	8.6
Lower North Fork Chetco	5.4	2.5	0.6	0.2	1.8	10.5
Middle North Fork Chetco	12.9	7.0	4.5	4.3	-	28.7
Upper North Fork Chetco	6.7	4.1	3.1	-	-	13.9
Mayfield Creek	5.0	2.1	2.1	0.5	-	9.6
Jim Ray Creek	4.6	1.5	2.2	-	-	8.2
Cassidy Creek	4.0	1.3	1.8	-	-	7.1
Bosley Butte	16.8	6.4	2.6	3.4	-	29.2
Ransom Creek	6.2	1.7	3.4	-	-	11.4
Upper Bravo Creek	15.5	3.4	2.0	1.8	0.9	23.6
Lower Bravo Creek	12.4	1.6	1.9	-	4.9	20.8
Total (%)	**90.8** 53	**32.9** 19	**26.9** 16	**10.2** 6	**10.9** 6	**171.6**
Drainage Density, mi/mi^2	**2.3**	**0.8**	**0.7**	**0.3**	**0.3**	**4.3**

[1] Relative position of streams, where all exterior links are order 1, and preceding downstream, the confluence of two like orders result in existing stream order +1. The junction of two different orders retains the higher order, and the main stream always has the highest order (Strahler 1957).

North Fork Chetco has a low gradient for a coastal stream. In contrast, the tributary drainages consist of narrow canyons with much steeper channel gradients. Tributary streams drain rugged mountainous land forms, from near sea level to 3400 feet at the northeastern end of Bosley Creek and generally start below steeply sloping headwalls. Longitudinal profiles of streams are useful to compare morphology between stream reaches or from one stream to another. Upper portions of Bosley, Cassidy, Upper Bravo and Upper North Fork have the highest average gradients. These are high energy erosional streams with a high capacity to move water and sediment. Lower portions of Bosley, Cassidy, Upper North Fork and portions of other streams are moderate to steep gradient streams. These are moderate to high energy erosional streams, with a moderate to high capacity to move water and sediment. Lower and Middle North Fork Chetco and flats along other streams are low gradient, which provide high habitat value. These are low energy, depositional streams.

III.5 EROSION PROCESSES

What are the dominant historical and current erosional processes within the analysis area (e.g., surface erosion, mass wasting)?

The dominant historical and current erosional processes are the same. Shallow rapid landslides adjacent to perennial channels, occasional deep seated persistent slides, gullying, and overland surface erosion are the four major erosional processes found in the analysis area. Shallow rapid landslides are by far the most common. Surface erosion, including gully and rill erosion, occurs on disturbed areas during intense rainfall or snowmelt events. Some slow earthflow creep is occurring in the northwest portion of the Upper North Fork drainage, but it is a very minor component when compared to the other erosional processes.

The relative percentage of each type of process has fluxuated since 1939. A fire in 1939, which removed much of the protective vegetation, increased the proportion of surface and gully erosion. As the land became revegetated, the relative proportion of surface and gully erosion subsequently decreased. In other parts of the analysis area, management activities, such as timber harvest, became the influencing disturbance mechanism increasing the level of mass wasting. Currently, there appears to be a reduction in the number of landslides and there is adequate vegetation cover to control surface erosion.

These erosional processes are the source of sedimentation in the stream system. The sediment routing mechanism involves; 1. initiation of a slide event or displacement from the surface, 2. delivery to the stream channel, 3. removal of the sediment from the high gradient streams, 4. deposition in the lower gradient portions of the channel, and 5. movement over time out of the watershed.

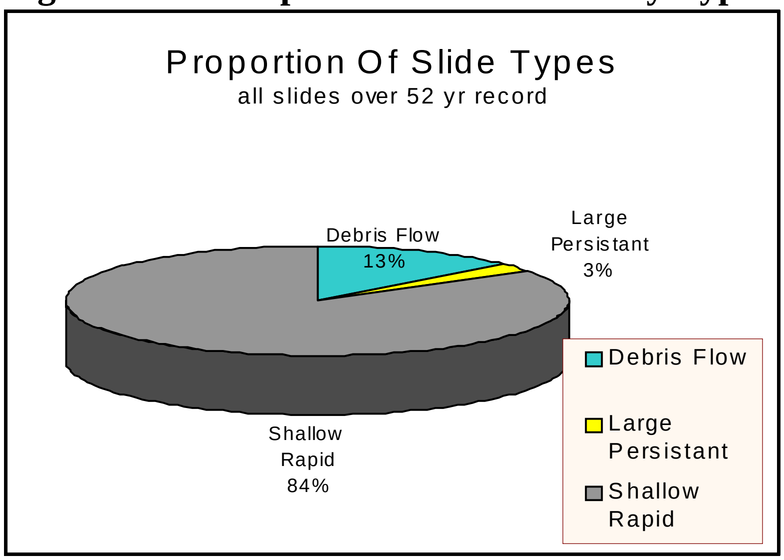
A major source of sediment comes from the stream undermining stream banks and adjacent debris slides. Rain storms increase the amount of water in the channel, which in turn influences higher areas of the streambank not normally available. This process increases the sediment contribution from stream banks and slides. In addition, this removal of bank materials steepens the hillslope and can initiate a shallow rapid debris slide in the riparian area.

What number of landslides have been observed within the analysis area and how are they distributed in time and space?

The 1940, 1955, 1970, 1986 and 1992 photo years were inventoried for a variety of data (Appendix A). From that data, the probable accuracy of the data, the number of slides per year, the number of slides by type, and the proportion of each slide type of the total for the photo year was determined.

It is difficult to determine natural rates of landsliding through forested canopies. It has been determined (USDA, 1997) that slides less than one half an acre are only detected with only a moderate degree of confidence with aerial photo methods. For slides that were visible on the aerial photos coverage from 1940 to 1992, it is felt that at least 78% of the time, the observed slide was not a road or narrow stream channel.

Figure III-7 Proportion of Landslides by Type

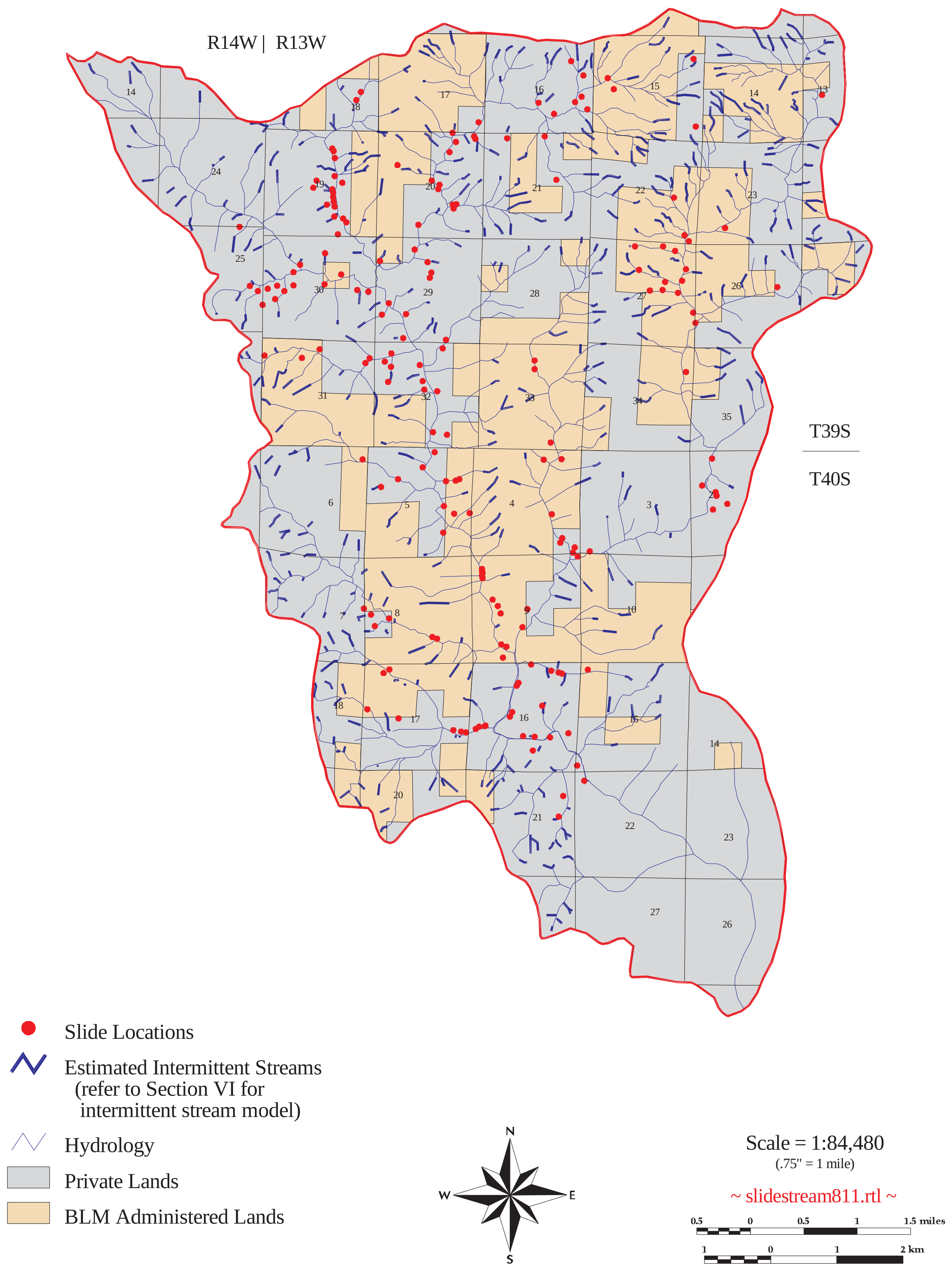


From the aerial photos, a total of 188 slides were identified. Shallow rapid landslides were 84% of the total slides, with channelized debris flows (torrents) being 13%, and large-persistent-deep seated flows comprising only 3%. (Fig. III-7) The average size of the shallow rapid slides was 0.9 ac on BLM lands and 1.2 acres on private lands.

The location of the shallow rapid slides is strongly associated with the combination of steep slopes adjacent to perennial streams (Fig. III-8) (refer to Section VI-Riparian Reserve Evaluation for determination of perennial and intermittent streams). Slides are most frequently associated with roads when located next to, or upslope from, steep perennial stream channels or on steep midslope areas. Due to the uniformity of the geology of the area (Dothan Formation), no correlation was found between slide locations and geologic formations. In addition, no strong correlation was found between slides and soil types.

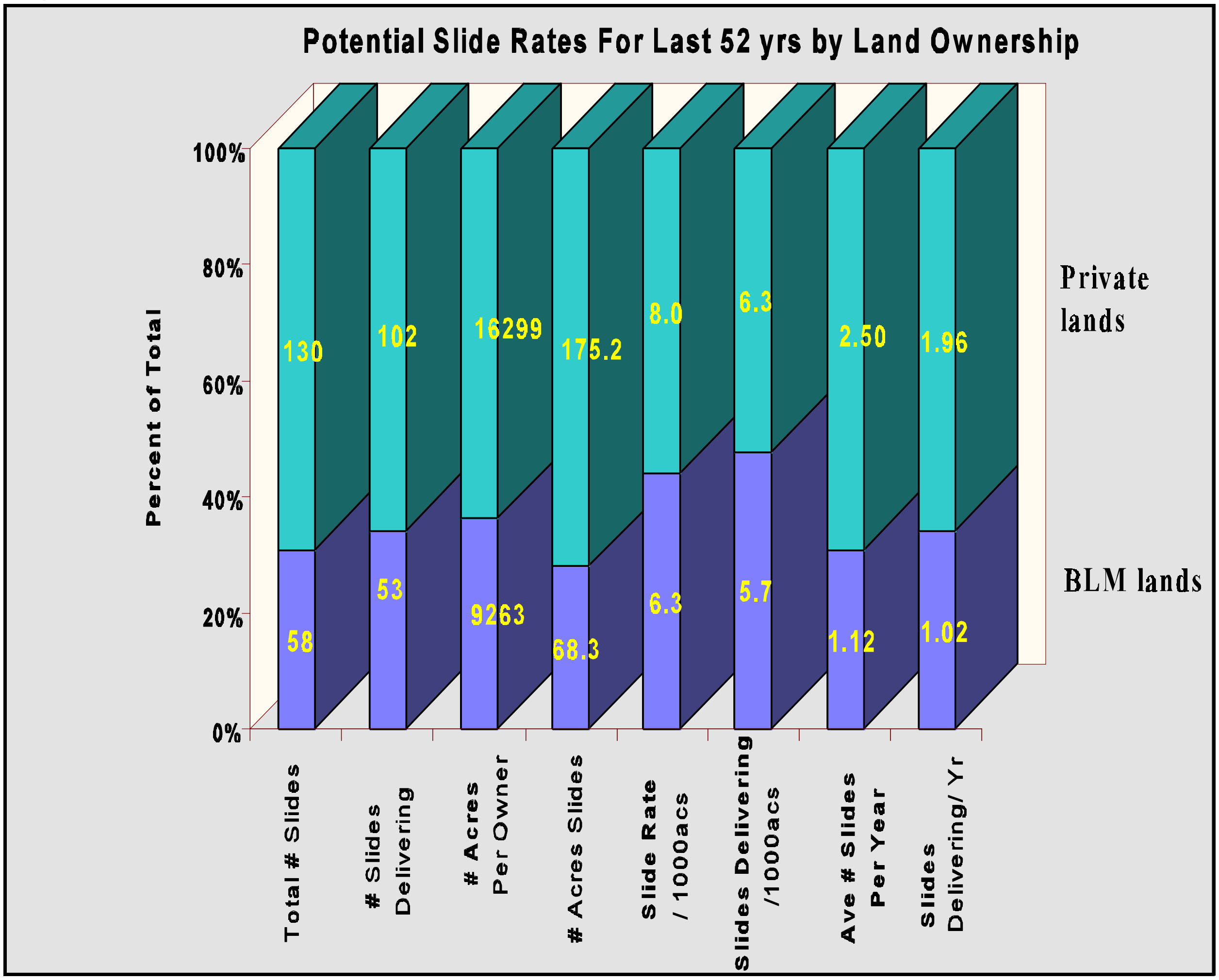
The likelihood of slide occurrence expressed as # of slides/ 1000 acres, was calculated as a measure for comparison of ownership, management activities, and drainage sensitivity. Because sediment delivery is of a primary concern, the incidence of those slides that delivered sediment to the streams was also determined. An overall landslide rate for BLM administered lands was calculated to be 6.3 slides/1000 acres, whereas, the rate on private lands equaled 8.0 slides/1000 acres (Fig III-9) . The number of slides which appeared to actually deliver sediment to the stream system was lower; 5.7/1000 ac for BLM and 6.3/1000 acres for private lands. Based on the confidence level of the inventory and these numbers, it appears that there is not a significant

Figure III-8 Landslide Distribution in Relation to Perennial and Intermittent Streams



difference in landslide rates between the different land ownerships.

Figure III-9 Landslide Information by Land Ownership



A yearly rate was calculated based on the 52 years of photo coverage and yielded overall rates of 1.12 slides/ yr. for BLM administered lands and 2.5 slides/yr. for private lands. A slight reduction was exhibited for slides that potentially delivered sediment to the stream; with 1.02 slides/yr. and 1.96 slides/yr. This rate is roughly equal to the ownership breakdown within the analysis area.

The Cassidy hydrological unit is the most sensitive at 19 slides/1000 acres (Figures III-10 and III-11). The Bosley, Lower Chetco, and Middle NFC drainages fall into the second most sensitive class with 9 to 11 slides/1000 acres. The Lower Lower NFC drainage was the least sensitive with less than 1 slide/1000 acres.

Figure III−10 Landslide Distribution by Hydrologic Unit

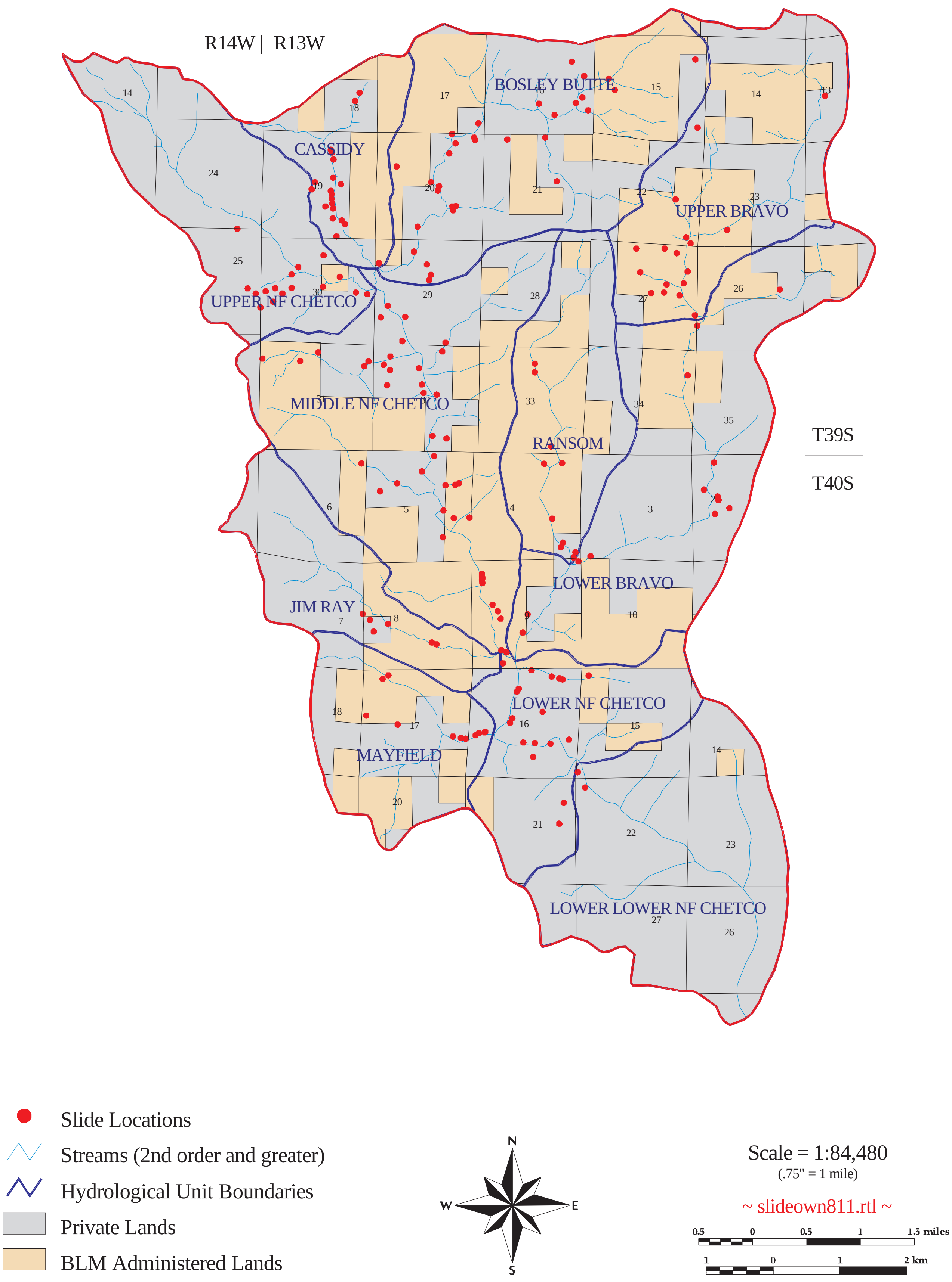
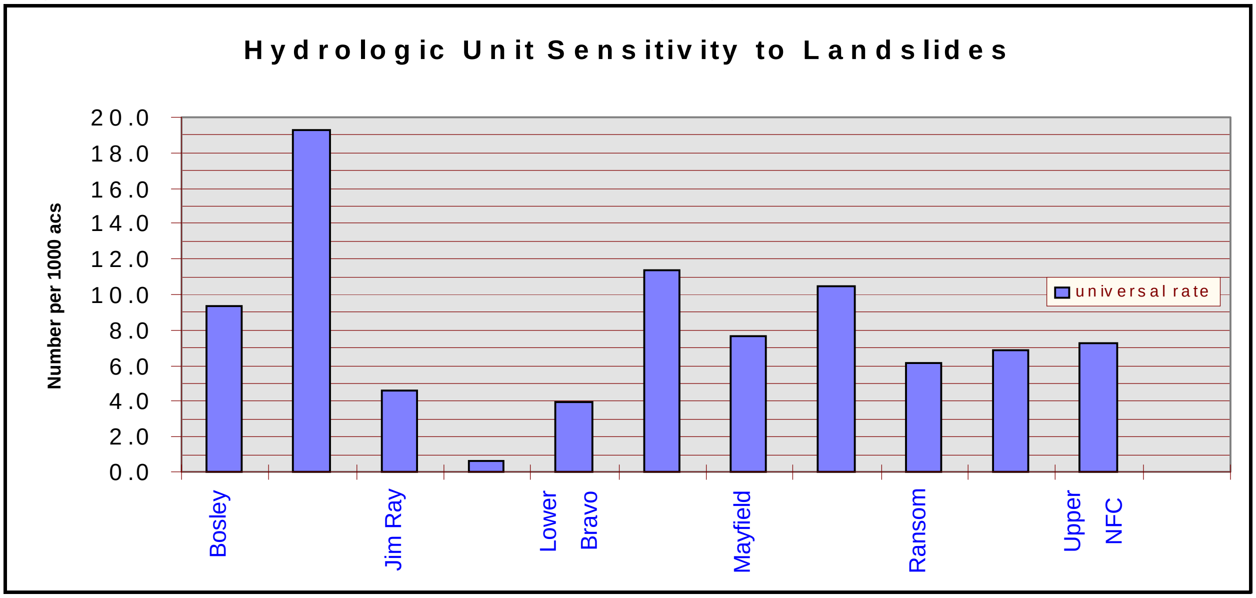
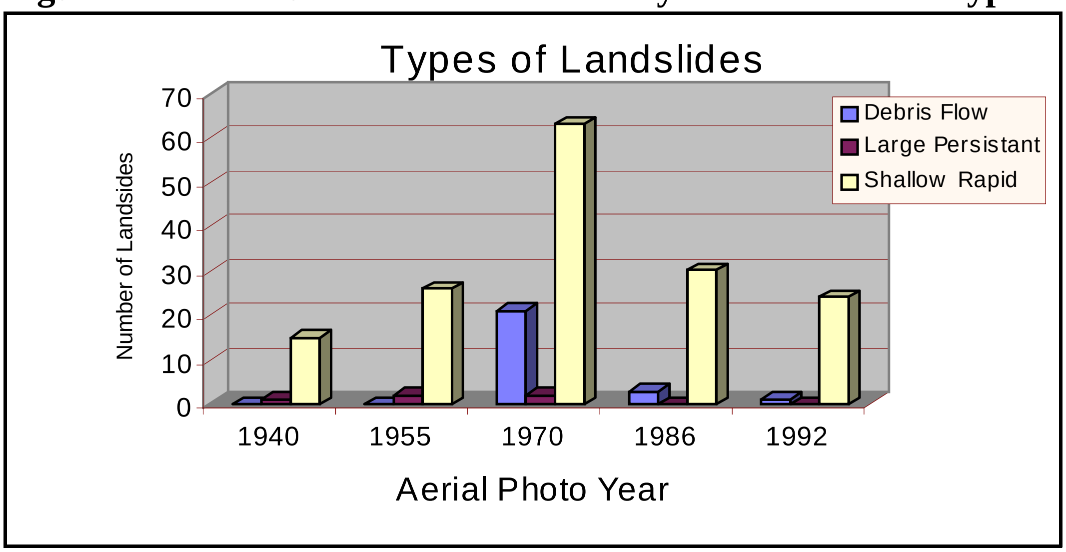


Figure III-11   Landslide Rates by Hydrologic Unit



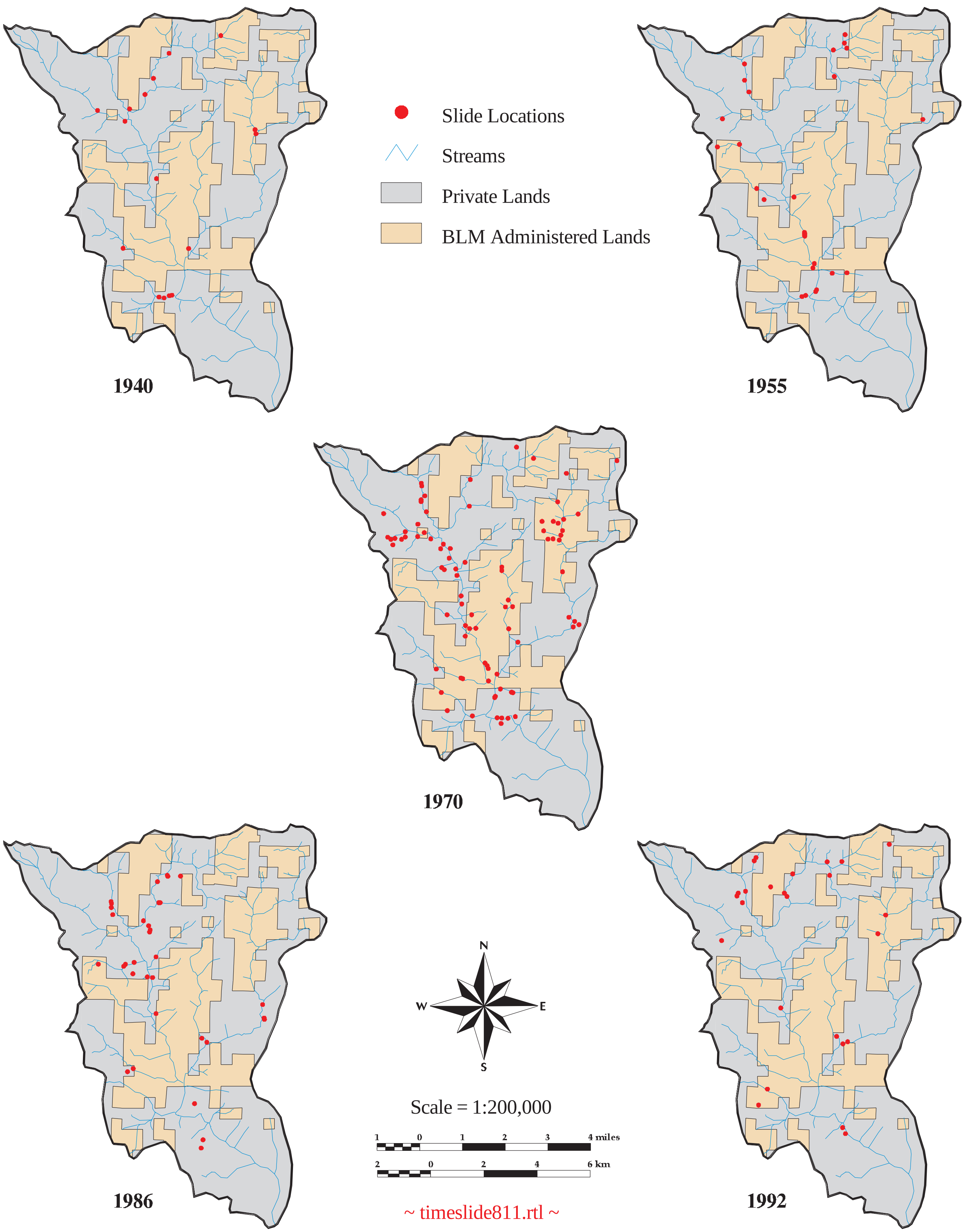
The number of landslides increased steadily from 1940 to a peak in 1970, followed by a reduction in 1986 and 1992. The 1992 level is slightly higher than that for pre-management levels in 1940. It should be noted that debris flows were not a component of the total prior to 1970, but were found to be approximately 25% of the total in that year and only 4% in 1992 (Figure III-12). The large persistent slides present in 1940 accounted for 6% of the total, were reduced to 2% in 1970 when all slides were at their peak, and were not present there after.

Figure III-12   Numbers of Landslides by Photo Year and Type



The spatial distribution of landslides by each photo year is shown on Figure III-13.

Figure III−13 Landslide Distribution Through Time (1940−1992)

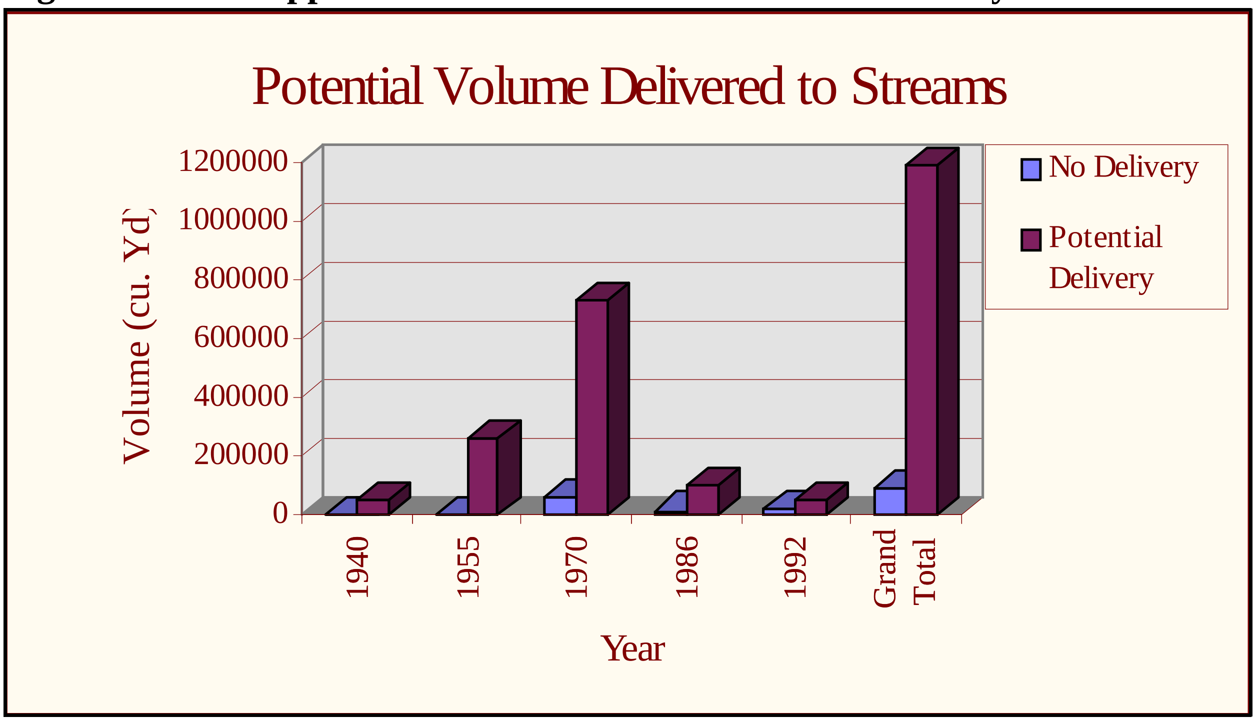


What approximate volume of sediment has been delivered to the stream channel from these slides?

The volume of slide material was estimated by measuring the surface area of the slide from aerial photos and assigning it an average depth by slide type. Shallow rapid slides were assigned a depth of two feet based on visual observations. A four foot depth was calculated for debris flows and a six foot depth for large persistent slides. As part of the photo interpretation, it was determined which slides deposited their material into or adjacent to the stream channel. These slides were classified as delivering sediment into the stream system. No field verification of actual delivery or delivery index was performed. For this analysis, all volumes are assumed to have been delivered as a worst case scenario.

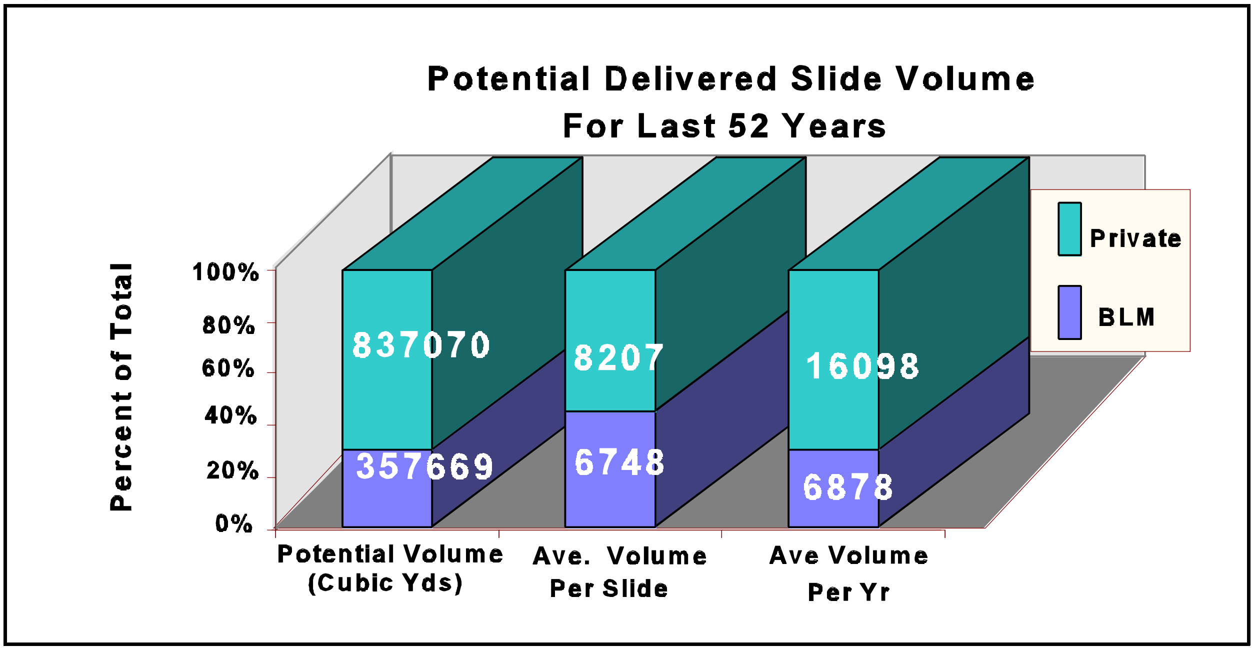
The amount of sediment delivered to the stream channel coincides with the numbers of slides over the years of study. The largest amount of delivery occurred in 1970, while the 1992 volumes approach that of 1940 (Figure III-14).

Figure III-14 Approximate Volume of Delivered Sediment by Photo Year



The entire analysis area receives approximately 23,000 cubic yards of materials each year, with an average of 15,000 cubic yards per slide. The majority of the volume per photo year comes from private lands (Figure III-15), but is in proportion to their percentage of land ownership. The average volume per slide is higher for BLM administered lands and may be a function of the steeper narrow channels that are found on the land surface.

Figure III-15 Volume Averages of Delivered Sediment by Land Ownership



A more common measure for the delivered volume was developed by estimating the area encompassed by the volumes. Assuming an average depth of 1 yard, the number of acres that the resulting volume calculates to be is 173 acres for private land and 74 acres for BLM lands. Over the 52 year photo period, private lands delivered 3.3 acres of land area into the stream system per year. On BLM lands, this acreage amounts to 1.4 acres per year. This method of analysis reveals a lower delivery rate for BLM lands with respect to its percentage of land ownership in the analysis area. At the peak of sediment delivery in 1970, all ownerships contributed a total of 151 acres of land to the stream system. In contrast, all ownerships reduced that contribution to only 10 acres in 1992.

Have management activities played a role in producing landslides?

Slide initiation was categorized as natural, harvest-related, or road-related. Slides that occurred 15 years after harvest were identified as natural (Zimmer, 1981). Management activities are responsible for 70% of observed slides. Harvest-related slides were 44%, road-related slides were 26%, and natural were 30% of the total.

Management related slides were first evident in 1955 and peaked by 1970. There has been a decrease in both natural and management related slides since then. The overall number of slides in 1992 approaches the level of natural slides in 1940. This pattern may be explained by drought years, change in management practices and/or the time since most of the more unstable slides have slid out during the 1955 and 1964 floods.

Management activities on all ownerships has resulted in more slides than would have occurred naturally (Table III-2). It appears from the distribution and numbers of slides that road building in the analysis area has elevated the number of slides above the natural rate on private lands, but not on BLM administered lands. Road building on BLM administered lands produced only less than one third the number of slides/ 1000 acres than the natural rate. Harvesting is the most significant land management activity for initiating slides in the analysis area. A one and one half fold increase above the natural rate was noted to occur across ownerships for this activity.

Table III-2 Landslide Rates by Various Management Activities

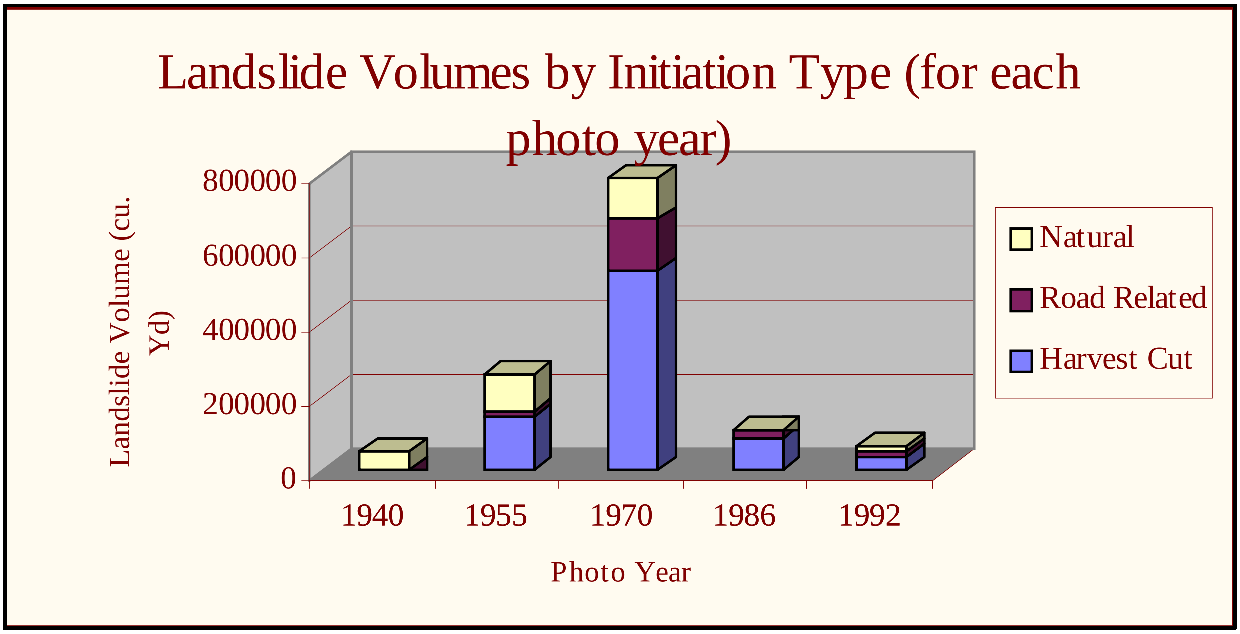
Number of Slides	BLM Administered Lands	Private Lands	Grand Total	Landslide Type # of Slides / 1000 acres	BLM	Private	Analysis area Average
Harvest Cut	30	53	83	Harvest cut	3.24	3.25	3.25
Natural	22	34	56	Natural	1.35	2.09	2.19
Roads	6	43	49	Roads	0.65	2.64	1.92
Total	58	130	188	Overall Rate	6.26	7.98	7.35

Increase from Land Management Actions over the Average Natural Rate for all Lands Within the Analysis Area

	Land Ownership Landslide Rate (# of Slides/1000 acres)		
Slide Types	BLM	Private	Overall Ownerships
Harvest	1.48	1.48	1.48
Natural	0.62	0.95	1.00
Roads	0.30	1.20	.88

Landslide volumes were estimated for natural, harvest-related and road-related slides (Figure III-16). Volume of material delivered was calculated to be the highest in 1970 with harvest related landslides made up the greatest percentage of the total. The total volume delivered reduced drastically after the peak in 1970. In 1992, harvest-related slides still contributed the greatest percentage of the volumes, but it was reduced by a factor of nearly 15 times below that of the 1970 value. The total volume delivered in 1992 is approximately equal to the 1940 volumes, but there was a shift from natural to harvest-related initiated slides. This pattern of landslide volume coincides with the number of each type of slide during that same time period.

Figure III-16 Volume of Delivered Sediment by Photo Year and Management Activity



The increase in delivered sediment volume between 1940 and 1970 is coincident with the highest harvest rate (43% of the analysis area) and road construction rate in the analysis area (refer to Section III.7-Disturbance Process). This time period also contained the 1955 and 1964 floods. Between 1970 and the present (27 years), an additional 25% of the analysis area has been harvested (some of the acreage harvested a second time). Along with the reduced harvest intensity, the harvest methods have changed as well. Most of the early harvest was performed by crawler tractor equipment and concentrated on removing only the Douglas-fir, leaving a partial canopy cover of tanoak. Later, harvest methods emphasized the use of cable systems capable of suspending at least one end of the log during in-haul.

How has the delivery of sediment affected other ecosystem processes (is., water quality, water channels, etc.)?

The delivery of sediment affects the aquatic resources most directly through the removal of habitat or increasing the turbidity in the water to such an extent that organisms are force to move out or perish from the increase. The turbidity measurements taken during the 10/94 through 11/95 time period provide some insight to the levels of turbidity expected in the analysis area. Generally, the water is very clear. Only after major storms have saturated the soils or a two inch per 24 hour event occur, does the level of turbidity increase over the 10 NTU level (refer to Section IV.1-Water Quality). Personal observations show that recovery of the stream to pre-turbid conditions happens fairly quickly after the recession leg of the passing storm. The sampling stations most affected by turbidity are the Cassidy and the North Fork Chetco sites. This may be due to the high clay contents within the drainages of Cassidy Creek and the Upper NFC.

High precipitation events move the sediment through the system downstream. As this occurs, other sediments are being removed from their storage places within the channel. During the early harvest and road building activities prior to the 1970's, this process added more sediment to the system than was able to exit. The high intensity 1964 flood may have caused the low gradient sections of the streams to aggrade by delivery of greater than normal sediment loads.

After the removal of timber from steep areas along 1st and 2nd order stream channels they commonly downcut adding sediment above the normal rate. This continues until the channel reaches a base level (bedrock or boulders) and the channel stabilizes. The amount of added sediment to the stream depends largely on the amount of rock in the parent materials and the velocity of the water in the channel. If few high precipitation storms are encountered, it seems that the channel can protect itself from further downcutting from then on. If channel flows get high and the rock layer is removed the process must start all over.

What level of compaction due to roads and other management activities exists within the analysis area?

Of the 222 miles of roads and identified equipment trails present in the GIS database, 79% are on private lands and 21% are on BLM administered lands. This overall mileage includes old dirt spurs and cat trails which comprise make up 35% (77 miles) of the total. Of these old spurs/trails, the majority 81% are on private lands and the remaining 19% are on BLM administered lands. These older spurs/trails can be either in a hydrologically restored state or in a severely degraded state, the condition is unknown for the majority of them. Field observations of these older spur roads disclosed no severely degraded roads on BLM lands.

The level of compaction from the road surfaces within the analysis area amounts to 1.7%. A width of 10' for older equipment trails and 20' for the established roads and adjacent cut banks was used. Compacted areas from roads on BLM lands amount to 1.1% of its land base and 2.1% for private lands. The GIS database appears to have captured the majority of the road surfaces normally associated with ground based systems, providing a more accurate calculation of the level of compaction. Normally these features are hidden by canopy cover and an assumption of the level of such features must be made.

The level of compaction due to harvesting on any land surface was not determined. However, given the rock content of the soils in the analysis area and amount of logging done with cable equipment, the expected impacts would be well below the amount for roads in the drainage.

What are the management objectives for erosional processes and sediment within the analysis area?

The management objective for the erosional and sediment processes within should strive to balance the input and export from the drainage over time. There should be an effort made to limit the delivery of sediment from the management activities such that it does not increase over the natural rate. Determining harvest areas that are with drainages sensitive to both sediment transfer and deposition is one way this objective could be met. Restoration of the transportation system to correct runoff and road surface problems is another example. Reducing the fine sediment delivery from the roads to the stream system is an objective that could be met in limited manner. Simply grading the roads to slightly outslope or crown most of the roads would reduce the fine sediment to many streams. The installation of additional culverts or more importantly the installation of drivable water dips would keep the buildup of ditchline runoff from occurring.

Reduction of compacted surfaces is often an objective of many restoration efforts. Sub-soiling of roads to remove compacted surfaces should not be a high priority in this analysis area. The high rock content of the soils keep infiltration rates high, even on road surfaces, and the amount of land out of production by compacted surfaces is low.

Removal of large fills at stream crossings to reduce the risk of sediment delivery is usually not an option in this analysis area. The presence of these fills themselves do not pose a problem. It is the culvert velocities and outlets that extend out past the fills that are causing increased sediment to be delivered to the stream. Most of the roads that are adjacent to the stream channels are main roads that have been improved and receive some level of maintenance. Most of the early roads (those built in the 1950 - 1960's) within the riparian area and did not get recent improvement may have been removed from use by the flooding in 1964. If not they are in some state of hydrologic recovery at this time, some where between moderate and full hydrologic recovery.

Overall meeting the Aquatic Conservation Strategy of the Northwest Forest Plan will accomplish the goals for management of the erosional processes within the analysis area. The levels of sediment delivery will not return to the past levels experienced in the 1960 and 1970 decades. Our past practices have changed, and they will not increase the amount of delivery during harvest and road building activities. Future activities under the NFP will ensure riparian protection and channel stability through the extensive network of Riparian Reserves.

III.6 HYDROLOGIC PROCESSES

What are the historical hydrological characteristics (eg., peak flows, minimum flows), and the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the analysis area?

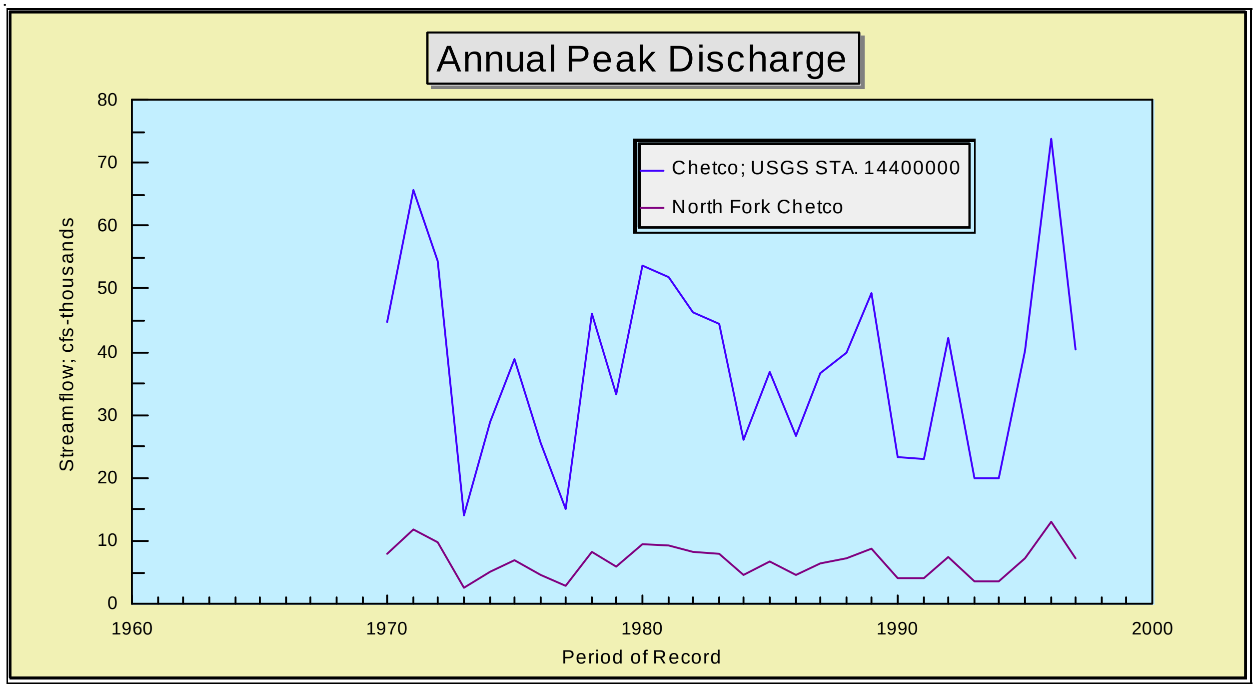
Forest hydrology is the study of the occurrence, movement, and distribution of water across forested watersheds and how they are affected by soils, geology, land form, vegetation and climate. The principal driver of hydrology in the analysis area is precipitation as rain of which a high percentage ends up as runoff. Precipitation events interact with landscape elements and this interaction has an effect on hydrological characteristics such as, floods, frequent discharge, low flow, and distribution of flow.

<u>Peak Flows and Runoff Processes</u>
Peak flow runoff is described as instantaneous flow, measured in cubic feet per second (cfs), as observed from long term stream gaging station data or calculated by basin characteristics

regression models, channel geometry methods, or estimated by other methods. Annual peakflow for a given drainage is highly variable from year to year. A frequency analysis of stream gaging station data establishes a relationship between the magnitude of the flood and its return period.

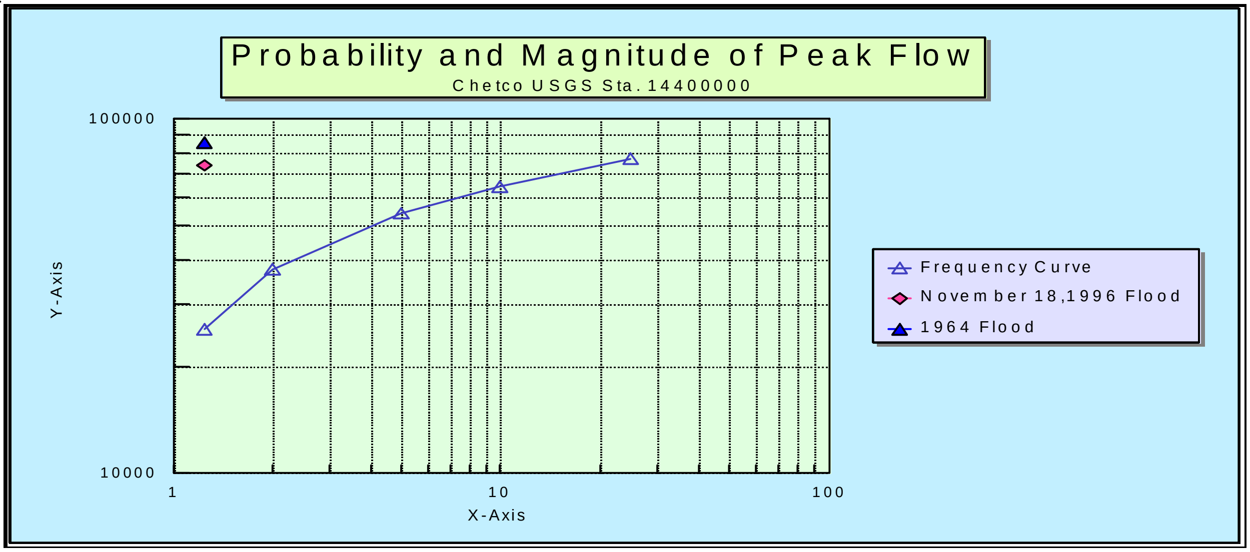
There are no precipitation or runoff gaging stations in the North Fork Chetco area, but a US Geological Survey gaging station is located nearby on the Chetco River. This station has been in operation since 1969 (28 years) and has a drainage area of 297 mi^2. Figure III-17 shows annual instantaneous peak flows for the period of record at the Chetco USGS station and a estimated hydrograph for the North Fork Chetco, developed by an area relationship. The 1964 flood, estimated from floodmarks, had a discharge about 16% higher than the November 18, 1996 flood.

Figure III-17 Comparison of Annual Peak Discharge between North Fork Chetco and Chetco Rivers



A flood frequency analysis is shown in Figure III-18 for the nearby USGS Chetco River gage. The analysis could not be extended upward from 25 years, due to the short period of record.

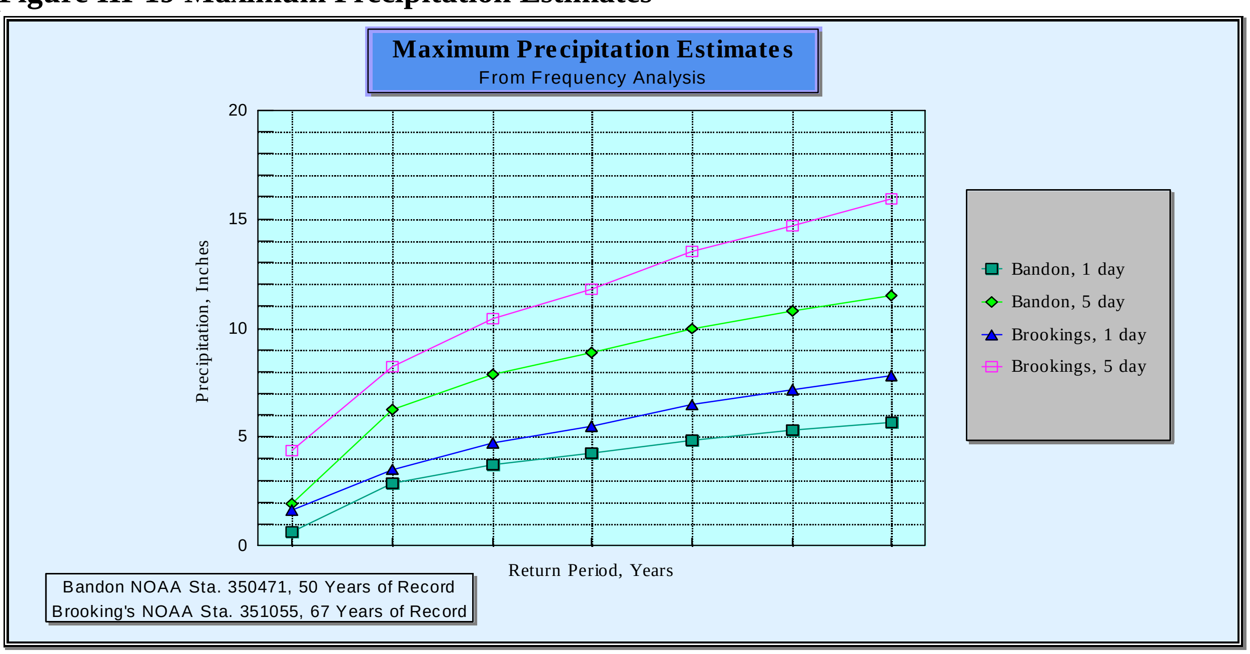
Figure III-18 Probability and Magnitude of Peak Flows



Examination of area gaging station records and interviews with local residents suggest that 1964, 1955, 1971, and 1996 were the worst flood years in the recent past.

Flooding that occurred on November 18, 1996 was probably less severe in the analysis area than in areas to the east and north, including the eastern parts of the Chetco, Pistol, Elk and River basins, and portions of the South Fork Coquille basin (personnel communication, Cindy Ricks, Siskiyou Nat. For.). The RAWS weather station at Red Mound, at 1753' elevation, and just west of the North Fork Chetco received 5.56" of rainfall on November 18,1996. Figure III-19 estimates that this precipitation frequency has a 14 year return period probability. According to the previous Figure III-18, this indicates that runoff from this storm imitated a 23 year event for the Chetco watershed.

Figure III-19 Maximum Precipitation Estimates



Discharge of bankfull and extreme flood flows were estimated for the analysis area using several methods (Table III-3).

Table III-3 Estimated Bankfull (2-year) and Extreme (100-year) Flows

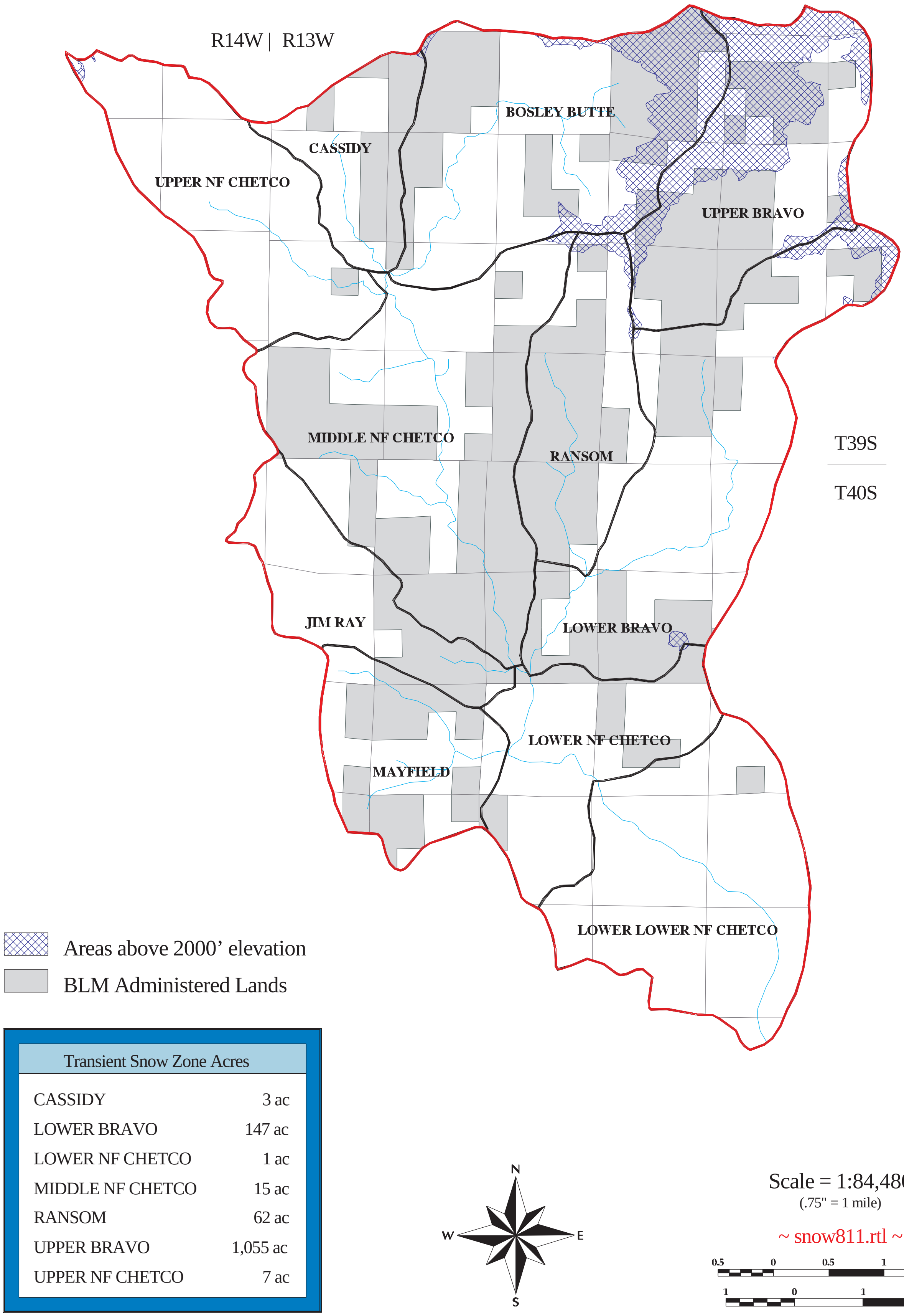
Method*	2 Year Flow (Bankfull) Estimate (cfs)	100 Year Flow Estimate (cfs)
Channel Geometry**	1050	5839
Basin Characteristics*** Regression with USGS Coastal Gaging Stations	4104	12993

* Estimated flows are for the entire analysis area (39.94 mi^2).
** Grant 1992
*** Adams, Campbell et. Al. 1986

Persistent rainfall or storms, especially those lasting several days to weeks, cause the stream network to expand as more of the soils become saturated and live flow again reappears in low order intermittent channels. To a large degree, runoff occurs by infiltration into the soils and subsequent subsurface routing to streams, once soil moisture deficits are satisfied. Exceptions are direct interception into streams or overland flow from roads or other compacted areas. Overland flow in undisturbed forest is seldom observed in Coastal forests because infiltration capacities are in excess of 2 inches per hour, which is much higher than the most intense hourly storm likely to occur in this area (4.5 inches in 6 hours) (NOAA 1973). Examination of available precipitation and stream flow records, reveals that about 85% of the estimated total runoff results from annual precipitation. The remaining losses include soil recharge, transpiration from the dense vegetation, and evaporation. Steeply inclined drainages, little groundwater storage, and steep stream gradients cause quick hydrograph response and flashy flow after the onset of rain. Stream hydrographs for an individual storm emphasize this short lag time with a steep rising curve, but a more moderate recession.

Precipitation as snow can accumulate above 2000' in the analysis area, but usually is transient and only persists a few days to weeks each winter. About 1300 acres (5% of the analysis area) has susceptibility to this come and go snow accumulation. This snow retention area is restricted to Upper Bravo (43%) and Bosley drainages (22%) (Figure III-20). Weather conditions including warm winds and rain can cause rapid melting of the stored water equivalent as snow pack. Snow will accumulate and melt faster in openings than the surrounding forest. This process can increase peak flows, depending on drainage factors and vegetative age and condition.

Figure III−20 Intermittent Snowzone Areas (Elevations above 2000')

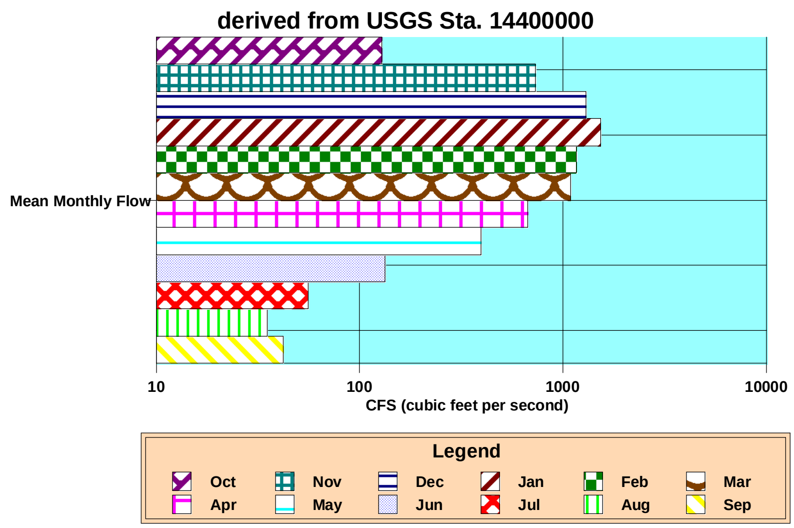


Transient Snow Zone Acres	
CASSIDY	3 ac
LOWER BRAVO	147 ac
LOWER NF CHETCO	1 ac
MIDDLE NF CHETCO	15 ac
RANSOM	62 ac
UPPER BRAVO	1,055 ac
UPPER NF CHETCO	7 ac

Annual Flow and Yield

Approximately 60% of the annual runoff occurs between December through February, with January being the highest month (Figure III-21). June through October contribute only 4% of the annual runoff and results in very low stream flows. This annual runoff distribution very closely follows the precipitation pattern. Annual runoff for the analysis area is estimated at 227,000 acre feet.

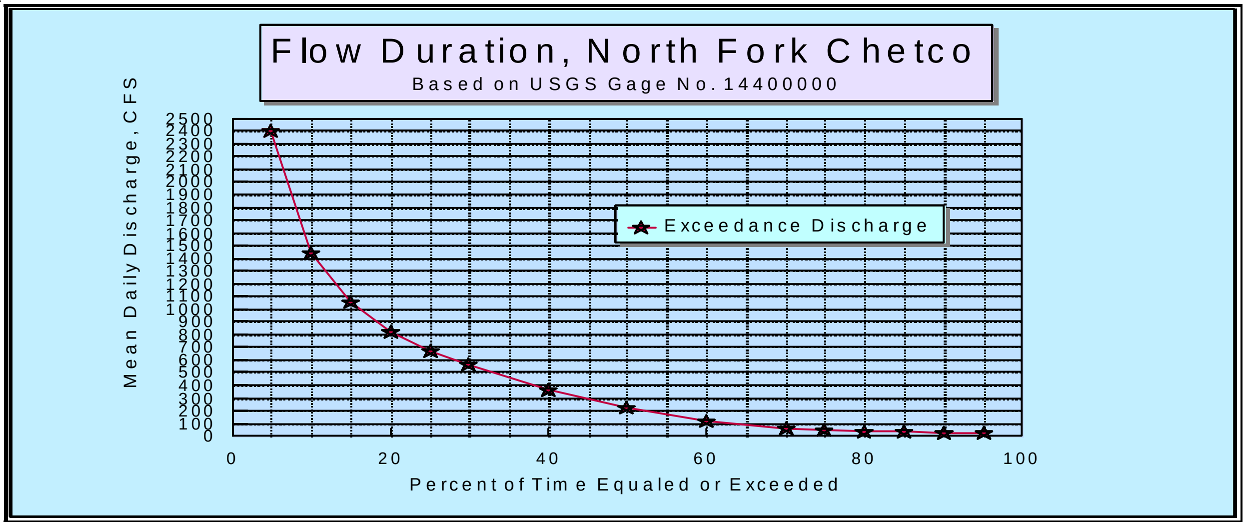
Figure III-21 Mean Monthly Flow for the North Fork Chetco Analysis Area



Flow Distribution

Figure III-22 shows how flow is distributed throughout the year in terms of flow duration. Bankfull to extreme flows occur less than 5% of the time, moderate flows occur 65% of the time, and low flows occur 30% of the time. Channel formation processes are caused by flows which fill the channel to bankfull or beyond, while channel dimensions are maintained by the frequent flows (flows less than bankfull).

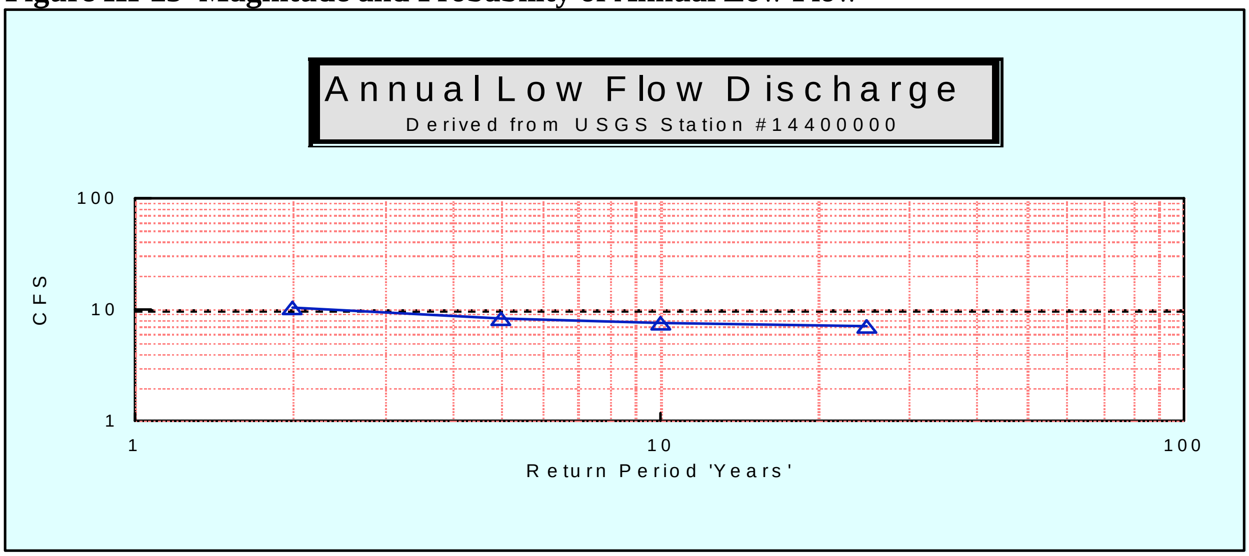
Figure III-22 Daily Flow Duration for the North Fork Chetco Analysis Area.



Minimum Flow

Because rain is infrequent in the summer, streams follow a normal recession and flows become extremely low in mid August-October along North Fork Chetco and other tributary streams. Tributary streams whose base level is above the water table can dry up. Figure III-23 shows an estimate of the magnitude and frequency of low flow in the North Fork Chetco analysis area. It should be kept in mind that these are estimates of the lowest live flows in North Fork Chetco for a consecutive seven day period for the indicated return period or years. This estimate does not consider live flow which may become subterranean and move under the channel in valley alluvium. The average 7-day low flow is about 0.25 cfs/mi^2 for a two year recurrence interval and <0.26 cfs/mi^2 for consecutive periods of up to 30 days. These values are nearly six times higher than other streams in the Coast Range Province.

Figure III-23 Magnitude and Probability of Annual Low Flow



Information from the long term USGS stream flow gage 14325000, near Powers OR. indicates that significant 7-consecutive-day low flows occurred between September-October in 1931, 1933, 1939, 1974, 1987, 1991, 1992 and 1994. It may be interpreted that low flows also occurred within the analysis area during these years. The return period for these 7 day low flows are 20 years or greater. The low flows in 1933, 1991, 1992 and 1994 were near 100 year events (Wellman et al. 1993).

What are the natural and human causes of change between historical and current hydrologic conditions? What are the trends?

Assumptions about flow changes from natural events or management activities are made based on hydrologic processes theory and research monitoring results elsewhere in the Coast Range. No stream gaging data exists in the analysis area to indicate if flows have conclusively changed from natural events or management activities.

Extreme Flood Flows

Little evidence exists to determine whether forest management activities have had an effect on the infrequent peak flows in the precipitation dominated Coast Range. Watershed studies in the northwest have shown that following road building and timber cutting, peak flows may increase, decrease, or remain unchanged. The magnitude of the change varies from a 36% decrease to 200% increase and depends on specific watersheds and storm factors (Reiter et. al. 1995). Historic flood flows (greater than a 20-year return frequency) have occurred in 1934, 1955, 1964, 1971, and 1974, and 1996. These floods were the result of natural weather patterns and flashy watershed response. Forest management has had little to do with significantly increasing the magnitude of these events.

Frequent and Moderate Flows

Frequent flows return several times each winter season and fill the active channel. These flows are responsible for maintaining channel dimensions and moving most of the sediment load. There is little evidence to suggest that these flow magnitudes, nor return periods, have changed for most of the precipitation dominated watershed. Regeneration harvest and road building in the Upper Bravo and Bosley drainages may have some effect on frequent flows, perhaps increasing them by 10-20%, if enough area in the intermittent snow accumulation zone is less than hydrologic recovery. Surface runoff contributions from roads, and water intercepted by midslope roads may be additive in the Upper Bravo and Bosley drainages. A considerable amount of rilling and gullying from compacted areas is apparent in this region (BLM personal observation).

Minor increases in the amount of daily flow in the spring and fall may result following harvest activities. This is a result of the younger vegetation transpiring less water and allowing more water to route to the stream channel. This increase is small and has little effect on overall flow.

Annual Yield

The amount of increased annual runoff in the analysis area is not known, but suspected to be in the range of 10-20%. Annual yield typically increases as a result of the effects of forest harvest and road building, or fire, as shown by studies in the Coast Range (Ziemer et. al. 1996). This increase is a result of reductions in evapotranspiration following the removal of coastal forest vegetation. The current vegetative condition shows 18% of the analysis area is less than 20 years of age and 38% less than 40 years of age. These are hydrologically immature timber stands, which use water at less than potential transpiration rates. As more acres of forest vegetation reach hydrologic maturity (±40 years old), this increased yield will decline. Sites where Douglas-fir and other conifer species are replaced with tanoak and red alder may reach hydrologic recovery at a younger stand age and rapidly decrease soil moisture storage and excess. (Hardwood stands have higher leaf area and evapotranspiration rates.) This stand conversion, whether by fire or harvest, may actually decrease annual yield when compared to conifer stands.

Timing of Flows

The response time of streams to Pacific storms have always been "flashy" because of limited soil and groundwater storage. It is thought that roads and clearcuts in a watershed act positively in advancing timing for a particular storm (Jones et. al. 1996). Roads and ditchlines may be acting as extensions of the stream network and channel the precipitation directly into the stream system. Midslope roads could be intercepting subsurface flow moving in a downslope direction. These factors result in a quicker rise of the stream flow followed by a quicker drop than may have happened in the past. Runoff from compacted areas can also advance this timing in the tributary streams.

Forest management may have a slight effect on advancing the timing of flows in the analysis area because of compaction, changes in evapotranspiration rates, and harvesting in rain-on-snow zones. However, the degree is uncertain.

Surface runoff from roads and skid trails can advance timing of flows, if more than about 8-12% of the analysis area is compacted. A cursory review of past aerial photography reveals that road, tractor roads and skid trail density may approach 5-8% of localized areas within drainages. Some of these roads have channeled water as gullies and captured stream channels, thus extending channels.

Where large areas are in young age classes, flows can occur earlier in the fall than in the past. Reduced transpiration from hydrologically immature trees results in increased soil moisture content. As the fall rains occur, less precipitation is needed to saturate these soils and the excess water enters the stream system either through primarily subsurface flow. This results in a rise in streams levels earlier in the year than under undisturbed conditions.

Rain-on-snow areas in the analysis area will respond with quicker runoff.

Minimum Flows

Low flows have undoubtedly been increased by regeneration cutting in the analysis area. However, changes in stream channel condition and species conversion to hardwoods, especially tanoak that are more efficient at transpiring water during the summer, may have diminished these increases. Management activities that change riparian areas from conifer to hardwood could have some effect on reducing low flows, because of increases in the transpiration rate.

Summer flows are a result of subsurface flow being released during the late spring/summer and is primarily dependant upon geology, soil types, soil depths and porosity. Upper North Fork, Lower North Fork Chetco, and a series of ridges throughout the analysis area have deep fine textured soils with moderately low permeability. Streams draining these areas have longer summer durations of streamflow.

Notes taken by U.S. Government surveyors on Sept 24, 1875, indicated that the North Fork Chetco River was dry near its confluence with the Chetco River in T.40 S., R.13 W., Sec 35, North ½ (Curry County Surveyor's Office). This channel drying condition was also observed in 1982 and may have been the result of channel aggradation from coarse sediments in the lower stream reaches. Much coarse and fine sediments entered the channels, during intense logging from 1950-1970, coincident with the 1955 and 1964 floods, and a high degree of inner gorge shallow rapid landsliding. Channel widening and inundation in many stream reaches are evident on 1969 aerial photography. It is plausible that aggradation occurred in many of the low gradient depositional stream types and this material was moved downstream and exported out of the analysis area over the next decade. Remaining coarse alluvium in the lower portion of the analysis area could cause channel drying, by allowing low summer flows to recede under the streambed.

During the 1990's, drought years some channel drying was again evident, leaving isolated pools in late summer.

Trends

Because of the ownership pattern, it is estimated that 50% of the vegetation will be in a early-seral condition at any one time. Annual yield may be permanently increased by 10-20% for sites with young vegetation, under this management strategy. Stand conversion to tanoak could decrease annual yield. A legacy of compacted roads and gullies over the last forty years will continue to deliver water to streams at a slightly faster rate. Full road decommissioning could disconnect ditches from streams and may slightly correct advanced timing. Risk of peak flow increase, probably in the range of 10-20%, may occur in higher elevation areas of Bravo and Bosley Creeks, depending on intensity of land management. Extreme peak and minimum flows are dependant on climatic patterns.

How have natural and human caused changes in water quantity and timing of flows affected water quality?

Changes in water quantity or timing, whether natural or management related effect slope stability and channel processes. Changes in sediment delivery could affect water quality and is the chief parameter of concern from flow changes in the analysis area.

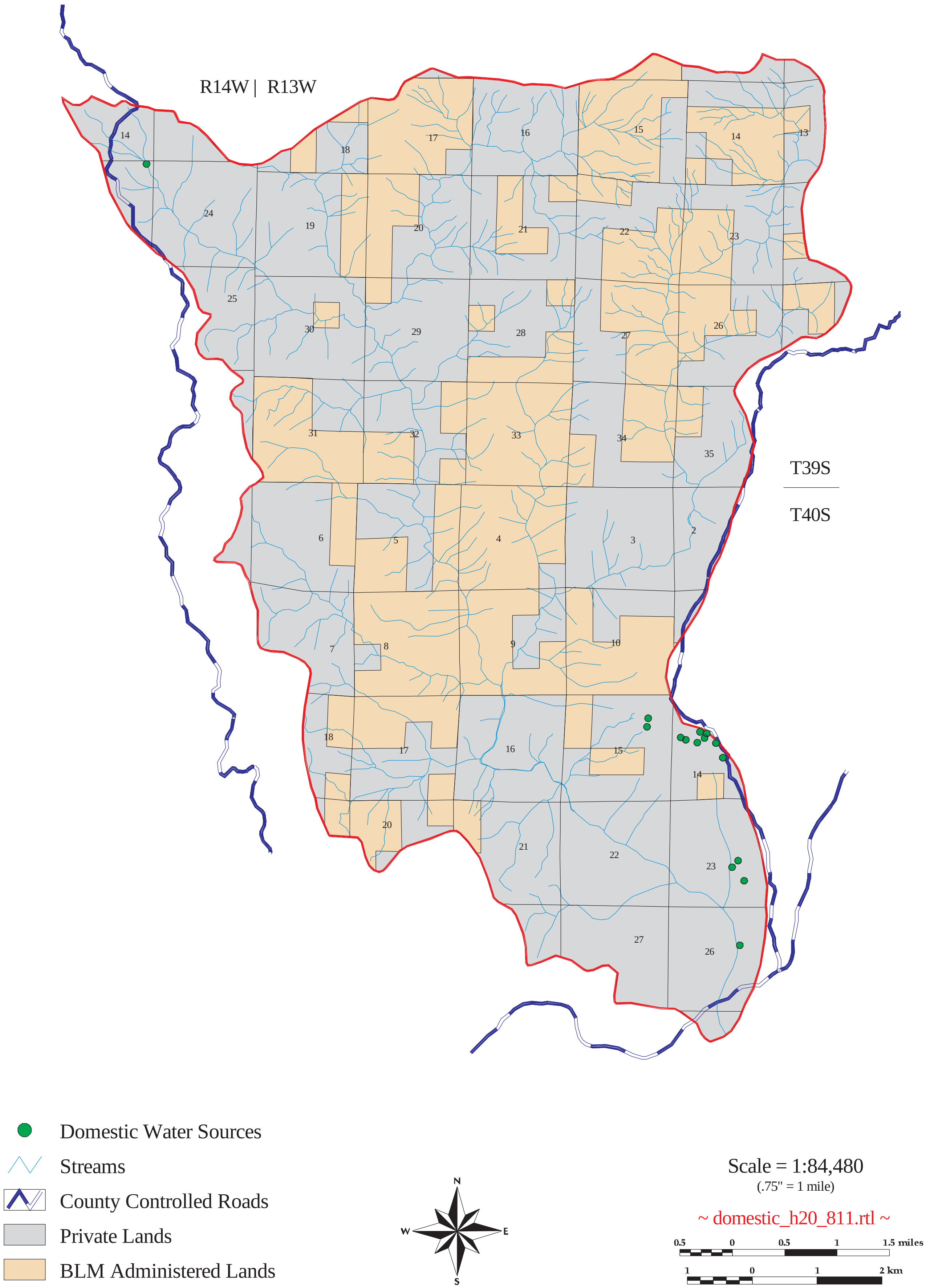
There is insufficient information to evaluate if natural flows or timing have changed. Precipitation is a stochastic processes and depends on probabilities and sequences of events. Discharges larger than channel forming frequent and annual flows that occur less than 5% of the time carry the majority of the sediment load. There are many source areas for sediment including historic shallow rapid slides from the inner gorges along streams that fuel the sediment supply. Sediment delivery is most active during large events. Turbid water decreases water quality during these events, but is short term and normally clears up in 1-5 days after precipitation slows.

Because of the pattern of road building, and regeneration harvest including tractor yarding and involving small first-second order streams in the last 40 years, many small drainages are not fully hydrologically recovered. Annual yield and perhaps peak flows for some of these small catchments either in the snow zone or that have high compaction density has increased. The degree of increase and the degree to which sedimentation is affected is not known.

How much surface water is being used for out of stream uses, and where are points of diversion (including domestic sources)? What effect does this have on available summer flow?

Surface water, springs and wells in the analysis area supply a small amount of drinking, domestic, and irrigation water to local residents living mostly along Gardner Ridge (Figure III-24). In addition, numerous wildlife and plant species are dependent upon the drainages for both

Figure III−24 Domestic Water Sources



drinking water and habitat. Available records obtained from District XIX Watermaster department in Coquille show that there are six permits or water rights for surface sources. Total withdrawal from springs and surface water is 0.2 cfs. Three sources are along Lewis Creek, tributary to the North Fork Chetco, one source is on the North Fork Chetco, and two sources are springs. A door to door water use survey was conducted and all willing occupants of residences within the analysis area were interviewed. Of the 10 residences contacted, four use springs, four use groundwater from wells and 2 use surface and groundwater. Surface sources use include the North Fork Chetco and a tributary Lewis Creek.

The known water withdrawals amount to only 2% of the 2 year 7 day low flow. This diversion amount is diverted low in the analysis area and appears to be insignificant to stream flows.

Water quality data of drinking water in North Fork Chetco is not available at present. Water quality testing is not required by state or federal laws because any one water system does not supply more than three households. Many of the surface-water withdrawal systems include a catch basin and/or settling tank to reduce particulates; some systems have neither.

ODFW has applied to the Oregon Water Resources Department for various minimum instream flows on the Chetco River (ODFW 1992). Application #70887 has a summer minimum flow of 55 cfs, or the natural streamflow, and is located between the confluence with the South Fork and Bravo Creek, with a priority date of 11/08/90. This application would greatly exceed the amount of available water during the dry period. Other streams in the analysis area do not have any instream minimum flow protection pending, but are at low risk for water withdrawals or flow modification.

What are the influences and relationships between hydrologic processes and other ecosystem processes (eg., sediment delivery)?

Peak flows have played secondary role in initiating debris flows and shallow rapid streamside slides. Limited floodplains, high stream flows may access and remove the toe of hillslopes along inner gorge, increasing the vulnerability of sliding (refer to Section III.5-Erosion Processes). Major channel adjustments have resulted from infrequent extreme flood flows (refer to Section IV.2- Aquatic Habitat). Low flows can affect the distribution of aquatic habitat and restrict the movement of fishes. Runoff and sediment delivery was higher for several winter seasons after fires, like the 1939 occurrence in Upper Bravo and Bosley Creeks.

What is the management objective for the hydrologic processes in the analysis area?

The management objective for the analysis area is to: A) continue with forest management and other activities in such a way as to minimize the risk of increasing peak flows or altering timing of runoff, and B) provide uninterrupted supplies of high quality water at the boundaries of BLM administered lands to domestic and other water uses.

III.7 DISTURBANCE PROCESSES

What naturally-caused disturbances occur in the analysis area? and how big are they?

<u>Wildfire</u>

Fire can be assumed to be the primary natural disturbance process for this part of southern Oregon Coast. Agee (1991) suggests a fire frequency of 90-150 years for coastal forests in southwest Oregon. Documentation as to how often, to what scale, and to what intensity that fire occurred, prior to the influence of Native Americans is not known. The Chetco Watershed Analysis (USFS 1996a) determined that lightning caused fires were relatively infrequent in number, averaging one lightning caused fire every 5 years since 1910. However, they were large in size, averaging 10,000 acres per occurrence. Fire activity reports from the Chetco Ranger District similarly support this relatively low level of lightning activity. The Chetco Watershed Analysis (USFS 1996a) also suggested that low intensity fires were more frequent than the more intensive stand replacement fires.

In order to determine a detailed fire history, an intensive analysis involving field examination of stumps and stand ages is needed.

<u>Fine scale disturbance</u>

Fine scale disturbances like individual tree and patch blow down, low severity fire, insects, disease, drought, snow breakage, flooding, stream bank erosion, and soil movement create small gaps throughout the landscape. These disturbances are present, but a determination of their frequency or scale was not conducted. Most stands were influenced by combinations of all these disturbance processes, occurring at varying frequencies and unevenly distributed throughout the stand and the subwatershed. These natural processes provide vegetative complexity and diversity at a variety of scales across the landscape.

<u>Landslides</u> - While landslides usually affect only small areas at a time, they appear to be a common form of disturbance in riparian areas within this analysis area. Far the most common form of landslides (84%) was determined to be the shallow rapid type, averaging 1.1 acres in size. The severity of this type of disturbance can be very high, resulting in loss of all soil down to bedrock in extreme cases. Landslides that reach the stream can deliver structural material (woody debris, and boulders), gravel, fine sediment, and fine organic matter. (refer to Section 1 - Erosion Processes for detailed information on landslides)

<u>Wind</u> - Wind has played a very limited role as a disturbance factor. For this part of the southern Oregon Coast, storms generally originate from the south and southwest. The orientation of North Fork Chetco itself is northeast-southwest. Areas of windthrow are generally located along east-west orientations, which parallels the current understanding of how wind storms affect windthrow (Andrus and Froehlich 1992).

A search through historical timber sale files reveal only one salvage sale which could be attributed to wind damage. The five acre sale (TS 71-57), was located in Sec. 21, T.40 S., R.13

W., adjacent to a recent clearcut, and on the southernmost ridge forming the analysis area boundary. Very small patches of blowdown, generally .5 acre or less, are observed scattered throughout the area in stands predominately dominated by tanoak. In 1995, a commercial firewood permit was issued for removal of this patch-type blowdown along roadsides in Section 17, T.39 S., R. 13 S.

Insect and disease - Laminated root rot and black stain disease can kill patches of sapling and pole size trees, but little evidence of these is noted in the analysis area. Bark beetles usually kill trees already weakened by other agents like drought, fire or disease, but may become epidemic following extensive fire or blowdown. Other pathogens and insects attack trees in this analysis area but none are known to cause significant mortality in established stands. (refer to Section V.4 for discussion on Port-Orford cedar root rot)

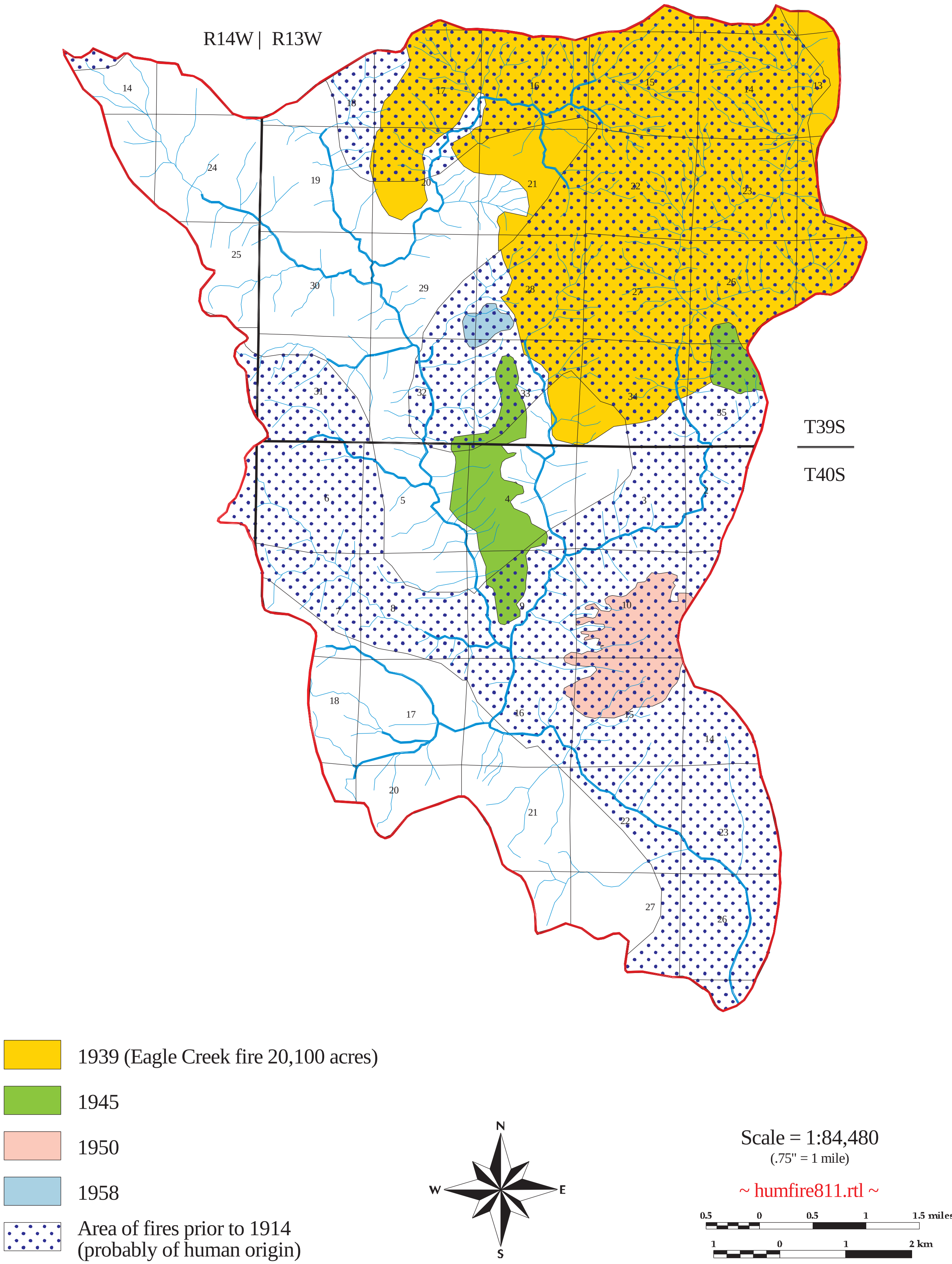
What are the human-caused disturbances in the analysis area?

Human-caused Fire

The historic landscape throughout most of the entire Coast Range, including the analysis area, was characterized by large, similar aged patches (ranging in age from 0 to 500+ years old) on the order of many square miles. Most of these patches were the result of large scale stand-replacement fire disturbances. Within and between these patches, scattered old-growth trees (i.e., remnant trees >160 yrs. old), patches of old-growth, and small patches of various younger age classes formed a varied mosaic pattern. Research by Ripple (1994) calculated that 61% of all conifer Coast Range forests were in old growth condition prior to the widespread fires of the late 1840s. These fires, thought to set by early white settlers, burned approximately 35% of the Coast Range (Teensma et. al. 1991) resulting in only 43% of the forests in old growth condition.

Repeated fires have occurred around the Bosley Butte area, in the northeast corner, and Palmer Butte area, in the southeast corner (Figure III-25). Prior to early Euro-American settlement, evidence exists that Native Americans played a large role in using fire to modify the vegetation for their purposes (Agee 1993). It is unclear as to the origin of fires prior to 1911, but the fires from 1939 on were of human origin based on documentation from the Oregon State Board of Forestry, (Appendix B-1). All of the fires occurred between August to October. Humans may have also been the cause of the fires prior to 1911. Zybach (1993) and Atzet and Wheeler (1982) concluded that European settlers started extensive and frequent fires throughout the Coast Range and Klamath Province in the mid 1800's. Anecdotal information supports this. Conversations with the Fire Management Officer at the Chetco Ranger District reveal that at the turn of the century, settlers in the Chetco basin frequently set fires to improve grazing conditions for sheep and prospectors set fires to remove the vegetation prior to explorations. Thus, most of the vegetation in the analysis area may have been altered in one way or another by human-caused fire.

Figure III-25 Location of Human Caused Fires Since 1914



Grazing
Around the turn of the century, many areas in the Klamath Province were grazed heavily by sheep and cattle (Atzet and Wheeler 1982). Fencing is still visible around some of the meadows in the analysis area suggesting that at least some of the area's meadows received some domestic grazing pressure.

Logging
Since the 1950's, logging has had as the most impact on vegetation. To date, 85% of private ownership has been harvested compared to only 18% of BLM's ownership (Table III-4). Aerial photography reveals that private landowners harvested over 60 % of their ownership by the late 1960's. Harvest on private lands began in the 1950's and was concentrated in the lower portions of the North Fork Chetco River in the southeast corner and along Old Highway 101 in the northwest corner of the analysis area.

Table III-4 Logging Disturbance by Decade

BLM Ownership (9,263 ac)			Private Ownership (16,299 ac)		TOTAL (25,562 ac)
Decade	Acres harvested	% of Federal ownership	Acres harvested	% of PVT ownership	
1950's	0	0 %	5833	36 %	23 %
1960's	69	< 1 %	4970	31 %	20 %
1970's	345	4 %	1156	7 %	6 %
1980's	641	7 %	2339	15 %	12 %
1990's	621	7 %	1010	6 %	7 %
Totals	1676	18 %	15,308**	85 %	61 %

** includes a total of 1485 acres of previously harvested areas in 1960's

Harvest methods during the 1950's and 1960's differed from the clearcut practices in the recent past. Most of this early harvest was performed by crawler tractor equipment and concentrated on removing only the Douglas-fir, leaving a partial canopy cover of tanoak. In some areas, this had the effect of converting mixed conifer/hardwood stands to those dominated by nearly pure tanoak.

A few areas which were harvested in the 1960's were harvested for a second time in the mid-late 1980's. Portions of private land in the lower portion of the analysis area, Secs. 21, 22, 26, & 27, T. 40 S., R. 13 W., appeared to have been poorly reforested, judging from aerial photos, and this harvest was concentrated in areas with a high red alder component. The commercial removal of hardwoods (red alder and tanoak) is strongly correlated with the fluxuations in the price of wood chips or other pulpwood raw materials.

The District policy to salvage of dead or dying trees during the mid-1960's to early 1970's was very limited. Documentation of timber harvest showed that only one salvage sale occurred, Section 9, T. 40 S., R. 13 W., between the Main Road and the North Fork Chetco River. The partial cut area was 38 acres. In addition, it was common practice on timber sales during the 1970's to fall or harvest dead trees within 200 feet of roads or the boundaries of clearcut units. Therefore, most snags and down logs within remnant stands may be at or near natural levels in the remainder of the BLM managed lands (refer to V.2-Terrestrial Habitat).

As part of forest management practices, herbicide application (on private lands) or manual cutting of noncommercial species to control competition generally occurs within the first 15 years following harvest. This has the effect of reducing the percentage of tanoak and increasing the percentage of Douglas-fir in these managed stands. However, visual observations and studies by Harrington and Tappeiner (unpublished) reveal that these treatments do not preclude the presence of tanoak as a viable component later in the stands development.

How have disturbances effected other ecosystem components (eg. hydrology, stream channel, vegetation, etc.)?

The hydrologic processes were most effected by the timber harvest during the 1950's and 1960's, which resulted in 43% of the analysis area being disturbed. Typical timber harvest practices during this time were tractor-logging and sidecast road construction. These practices were exacerbated by the 1955 and 1964 floods, both 100 year events, to produce the highest rate of landslides found in the analysis area (refer to Section III.5-Erosion Processes). These landslides resulted in the input of large amounts of sediment into the aquatic system (refer to Section IV.2-Aquatic Habitat).

Steam channels were similarly effected during this same time frame. The combination of the removal of large down wood and high inputs of sedimentation had degraded the aquatic habitat. Large trees, which act as recruitment potential for down wood, were removed in some areas (refer to Section IV.2-Aquatic Habitat). Currently, as the age of residual stands increase, the aquatic habitat is trending towards recovery.

The overall vegetation has been most effected by frequent fires, predominately human-caused. These fires have altered the species composition of the vegetation towards stands predominant in tanoak (refer to Section V.1-Vegetation). Early logging practices of high grading (removing the large Douglas-fir left from the fires) completed the transformation in some areas.

Terrestrial habitats have similarly been effected by timber harvest. 61 % of the analysis area has been transformed into younger generally, structurally simplified stands. Key components, such as down logs and snags have been removed during the process (refer to Section V.2-Terrestrial Habitat).

IV AQUATIC AND RIPARIAN ECOSYSTEM

IV.1 WATER QUALITY

What are the historic and current processes delivering sediment to tributary streams and along the North Fork Chetco River?

There has always been a natural source component of sediment delivery to stream channels. Landsliding, debris avalanches and debris torrents, streamside shallow rapid movements, surface erosion after historical fires, stream channel sediment adjustments and flooding have contributed soil material.

The principal current processes delivering sediment to tributary streams and along the main river in the analysis area include shallow rapid hillslope failures adjacent to channels (84%), debris avalanches and flows resulting in debris torrents (13%) and large persistent deep-seated slides (3%) (refer to Section III.5-Erosion Processes).

What is the response of the analysis area to storm events in regard to producing sediment?

The higher stream discharges that occur several times a winter and infrequent extreme events carry the majority of the sediment load. Flooding can cause landsliding and delivery to streams, and extend the stream network to capture unconsolidated colluvium in ephemeral channels and hollows. High flows which carry the greatest sediment loads occur less than 5% of the time (Figure III-22).

Turbidity measurements were taken during the 10/94 through 11/95 time period at five sites in the analysis area (Figure IV-1). Turbidity is a measure of the cloudiness of water, and can be correlated with a suspended sediment load. A source search turbidity study was completed over a two-year period. Pre-storm samples were collected and compared with several storm periods at one location in selected drainages. Results show that during non-storm times, turbidities were low at all sites (example; 7/13/95, range of 0.9-2.2 NTU). During storms, turbidities increased 11 to 67-fold on January 10, 1995, and 180-fold on November 8, 1995. These increases are correlated with a 24-hour precipitation of 2.0" or more (Figure IV-2). Of the drainages surveyed, Cassidy, Bosley and Middle-Upper Chetco had the highest levels of turbidity. This may be due to the high clay contents within the drainages of the Cassidy Creek and the Upper North Fork Chetco. Somewhat lower turbidities were noted in Bravo Creek during storms.

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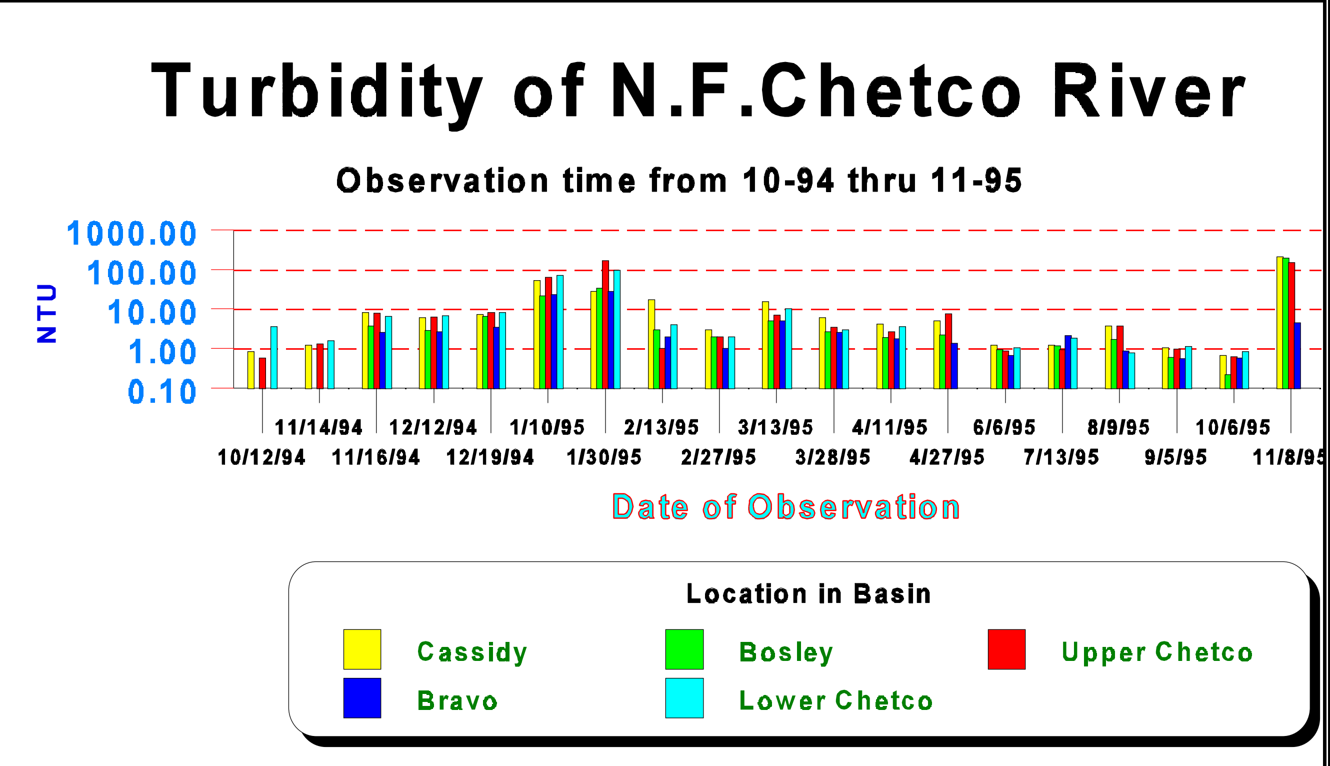
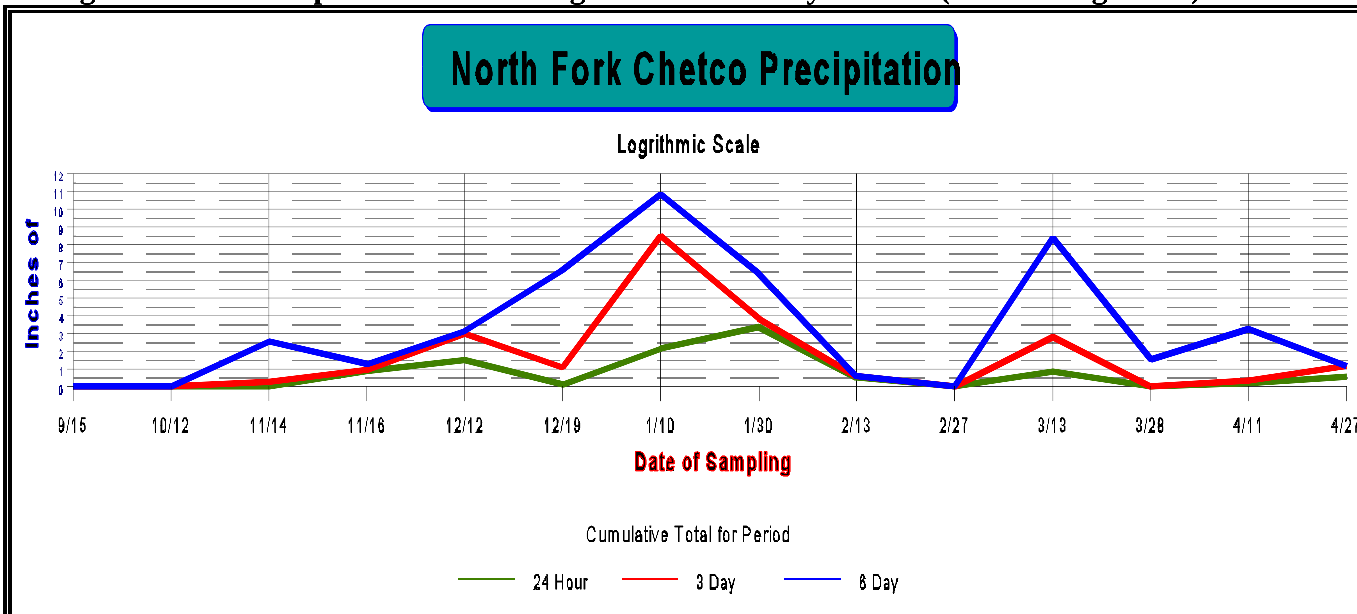
Figure IV-1 Sediment Monitoring within the Analysis Area (10/94 through 11/95).



Cass	0.83	1.20	8.00	6.00	7.30	51.0	28.0	17.0	3.00	15.0	6.10	4.08	5.07	1.23	1.23	3.74	1.04	0.68	206.
Bosl			3.70	2.90	6.40	21.1	34.0	3.00	2.00	5.00	2.70	1.88	2.20	0.94	1.15	1.71	0.59	0.22	194.
Uppe	0.58	1.30	7.70	6.20	8.20	61.8	166.	1.00	2.00	7.00	3.40	2.64	7.56	0.87	0.92	3.77	0.97	0.62	148.
Brav			2.60	2.70	3.40	23.1	28.2	2.00	1.00	5.00	2.60	1.77	1.36	0.67	2.15	0.87	0.56	0.58	4.45
Lowe	3.60	1.60	6.50	6.80	8.00	70.4	95.1	4.00	2.00	10.0	3.00	3.64		1.05	1.81	0.79	1.11	0.84	

Figure IV-2 Precipitation Monitoring within the Analysis Area (9/94 through 4/95).



24 Hour	0	0	0	0.86	1.48	0.12	2.13	3.38	0.51	0	0.85	0	0.21	0.57
3 Day	0	0	0.26	0.94	2.99	1.1	8.5	3.82	0.59	0.01	2.85	0	0.36	1.19
6 Day	0	0	2.54	1.26	3.16	6.57	10.83	6.36	0.59	0.01	8.36	1.52	3.26	1.19

How quickly can the analysis area recover from the effects of sedimentation after a major storm event?

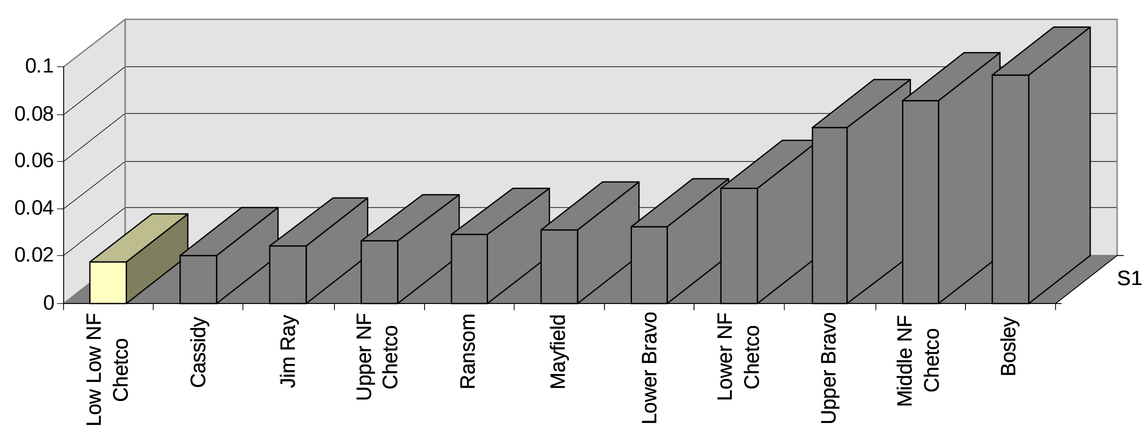
Generally the water is very clear and clouds (NTU>10) only during major storms. Visual observation of the recovery of the stream to pre-turbid conditions happens fairly quickly (2-5 days) on the recession leg of the hydrograph as the storm passes.

Where are the source areas contributing to sedimentation in streams. Which streams are vulnerable to sediment transfer and deposition. Is sediment suspected to interfere with beneficial uses?

Source areas include delivery from streamside hillslope failures, bankcutting, landslides and delivery to channels from compacted areas including roads. (Refer to Section III.5-Erosion Processes).

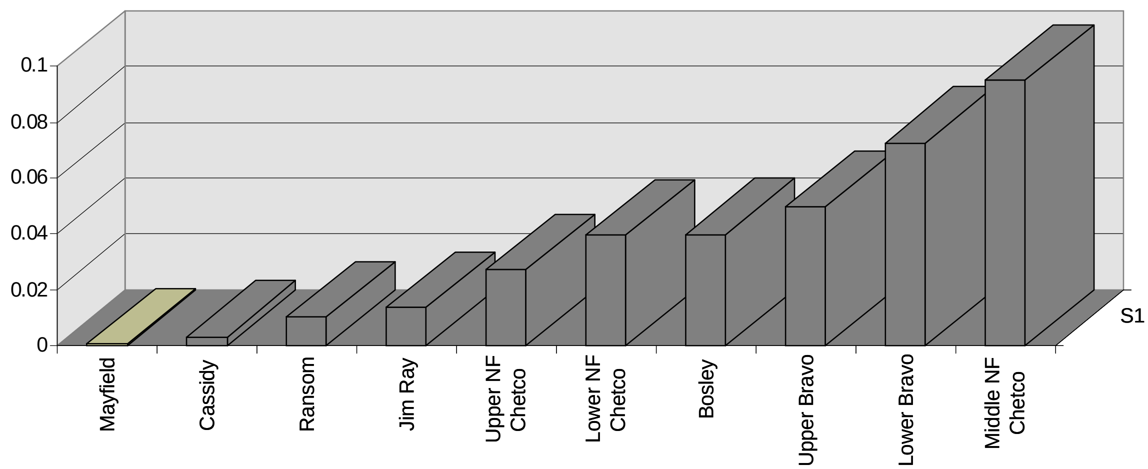
The likelihood of sediment routing downstream (transfer) was determined for the analysis area using a model by Geier et al. (1995). The sediment transfer hazard represents the transport efficiency of the streams, the stream flow, and fluvial energy of the drainage. The bankfull flow is closely associated with the 2-year flood event. Figure IV-3 shows a comparative sediment transfer hazard for the eleven hydrologic units in analysis area. Bosley, Middle North Fork, and Upper Bravo have the highest efficiency and highest potential of transferring sediment downstream, introduced from landslides or other sources. Bosley and Bravo Creek are higher elevation drainages, can collect snow and therefore have higher runoff potentials. Middle North Fork drainage has a higher drainage density and moderate relief, and is able to collect and route sediment through many of the reaches. The remaining drainages have some combination of lower drainage densities, lower total relief or lower bankfull discharge, compared with the remainder of the analysis area.

Figure IV-3 Streams with High Transport Efficiency



Sediment depositional hazard was estimated for the analysis area using a model by Geier et al. (1995) (Figure IV-4). The index includes the proportion of low gradient streams (<2%) in a hydrological unit multiplied by a discharge coefficient. Low gradient streams in Bosley, Middle North Fork Coquille and Upper Bravo drainages have the highest depositional hazard. Mayfield, Cassidy, Ransom and Jim Ray hydrological units include the lowest risk for sediment deposition in low gradient streams, due principally to the steep nature of the drainages.

Figure IV-4 Streams with Sediment Depositional Hazard.



Fine sediments (<2.0 mm, including clay/silt and sands) are moved quickly downstream during storms and do not tend to accumulate in appreciable amounts in the drainages, even in low gradient reaches. Data collected at sites within the analysis area suggest that appreciable fine sediment volumes do not remain in the channel and are exported during the frequent flows. Pebble count sampling was completed in low gradient (generally <2%) depositional reaches in all 11 hydrological units (Appendix C-2). Results show that generally less than 15% of all surface substrate material fit the fine sediment category. In addition, visual observation of many stream channels does not show accumulations of fine materials.

Results of the pebble count sampling show that generally 70% or more of all surface substrate material fit the coarse sediment category. Deposition by coarse sediments (>2.0 mm, including the gravel and cobble sizes) in stream channels can be temporary or chronic. Persistent or overwhelming deposition and an available sediment source can lead to channel aggradation in low gradient reaches. Aggradation of coarse sediments raise the stream bed base level. Loss of late summer streamflow in alluvial reaches can occur, as minimal flow becomes groundwater (refer to Section III-6 Hydrologic Processes - low flow discussion). These and other factors can lower the habitat quality of stream reaches by increasing channel width and decreasing pool area and depth.

Slides occurring during big storms may temporarily dam the channel as large volumes of sediment and organic material move downstream, such as the large slide that entered Bosley Creek about 1992. Elsewhere, shallow rapid movements inside the inner gorge have partially to totally blocked channels and were particularly frequent during the 1940-1970 period. There are terraces in some channels, with hardwood colonizing on the surfaces that appear to be relics of the 1964 flood. Coarse sediment is temporarily stored in the channels from these pulses, but does not remain for long time periods due to relatively high stream gradients.

The routing of sediment has been slightly altered by the addition of stream crossing culverts to the landscape. Not all culverts are restricting the passage of bedload downstream, but a notable number have backed up larger sized materials. These culverts area characterized by level gradients or slightly less than level (.5%), floatable debris has partially blocked the culvert, or where the inlets have been deformed. Large and deep fills generally are associated with stream crossing culverts in the analysis area. Culvert outlets can produce high velocities of water from "shotgunned" pipes. This extra energy fills further remove the armor layer trying to establish itself in the channel and may undermine road fills.

Coarse sediment may be interfering with beneficial uses including fish and aquatic life for short periods (1-10 years) as the material is moved downstream, but probably not on a sustained basis.

Are there, and if so where, are roads that are contributing sediment to streams? What is the future monitoring and management of the road system to reduce sedimentation and other potential problems?

Roads alter the hydrology of drainage in several ways: increased surface runoff from compacted roadways, interception of subsurface water by cut slopes, and more rapid routing of water to stream channels via road ditches and culverts. In essence the ditch system may operate much like an extended stream network. All of these effects tend to result in increases of annual yields and peak flows.

Within the analysis area, approximately 82% of the road system is natural surfaced (25 miles of BLM and 94 miles of private road). The remaining system is predominately gravel, including the main access roads within the analysis area. The county roads which are along the area boundary are paved. Roads that are inadequately maintained and lack a vegetative cover, resulting in gullying, are sources of sediment.

Delivery of fine sediments from natural road surfaces occurs within the analysis area. Not all roads deliver sediment and it does not appear to be an active process unless there is over saturation of the road surface by intense rainfall, usually 2 inches/hr or more (BLM, visual observations over 8 years). When the permeability rate is exceeded along roadways, splash, rill, and gully erosion are frequently noted. Because ditch relief culverts are inadequately spaced, runoff collects for large distances prior to finding its way off the road prism. It is this excessive collection of water and fine sediment and subsequent diversion back into the main roadway that is a problem in the analysis area. This inadequate design for road drainage impacts the stream network where the collected water reaches a stream. Fine sediments and extra volumes of water may be added to streams and could advance runoff in a storm. However, many of the runoff ditches empty on to vegetated surfaces and filtering of the water takes place. Newly constructed or maintained road surfaces contribute fine sediment until vegetation becomes established, or until erosion removes fines from the surface leaving rock as an armor. The inherent high rock component of the parent materials aids in this type of recovery. Erosion effects are highly variable depending on concentration of water. Once gullying starts it is slow to recover in the analysis area.

Roads above 2000 feet in the upper Cassidy, Bravo and Bosley drainages have significant rilling and gullying. There is also rilling and gullying occurring on old skid roads and fire trails in these drainages. Intense rain and occasional snowmelt at higher elevations, coupled with silt/clay erodible soils on the ridgetops, are factors leading to rill and gully erosion.

The TMO process identified several roads contributing sediment and recommended varying actions (from decommissioning to improvement). This interdisciplinary process by specialists is used to set management and maintenance levels. Listing of individual roads is located in Appendix F-2.

Are there reaches where summer stream water temperatures are above State ODEQ Water Quality Standards? Which stream segments have frequent accedences?

Streams in southwestern Oregon are known for their relatively high summertime temperatures, but it is not clear whether this is related to a latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta et al. 1987). Monitoring of stream temperatures during the drought of 1992 did not show a strong correlation between maximum stream temperature and elevation (Oregon Forest Industries Council 1993). It is known that direct daytime heating of stream water (from lack of shade) during critical summer months when the incoming solar radiation load is high, is a principal factor to explain increased temperatures. It is also known that temperatures increase in a downstream direction.

Elevated water temperatures have been noted throughout North Fork Chetco, although actual recorded data is quite limited. High temperatures are attributed to loss of riparian vegetation providing shade, wide and unshaded lower stream areas, and low flows. Lower North Fork Chetco and Bravo Creek were was listed on ODEQ's 303(d) list of water quality limited streams. The seven-day rolling average maximum temperature exceeded the basin criteria of 64 °F for several periods during the summer. Temperature monitoring information is shown in Table IV-1 (station locations are shown in Appendix C-2).

Table IV-1 BLM 1995 Temperature Monitoring Summary for North Fork Chetco [1]

Streams	Seasonal Max.	Date	Seasonal Min.	Date	Delta T	Date	7 Day Max.	7 Day Min.	7 Day Delta T	Days >64°	Seasonal Max. 64°
NFC near mouth	77.6	8/03/95	58.1	8/26/95	15.5	8/03/95	75.7	63.1	12.6	57	13.6
NFC near Mayfield Crk.	71.7	8/04/95	49.4	6/20/95	11.2	8/19/95	70.1	60.8	9.3	61	7.7
Bravo Crk in Sec. 2	74.4	8/04/95	47.8	8/20/95	13.4	7/31/95	72.2	60.5	11.7	31	10.4
NFC at bridge above gorge	65.9	8/04/95	54.2	7/3/95 8/26/95	5.7	8/03/95	64.5	59.9	4.7	5	1.9
Bosley Creek	63.5	8/04/95	48.4	6/20/95	4.2	6/24/95	62.3	59.3	3.0	0	0

[1] Definitions:

Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. 64° - Number of degrees seasonal max. is above 64° F

A 7-day ΔT >5 °F indicates that mid-afternoon stream temperature elevates daily in response to increased direct solar radiation. This is observed in stream reaches where riparian vegetation canopy has been removed, or in very wide stream channels that do not receive topographic or riparian shading.

Stream temperatures in the analysis area generally increase in a downstream direction coinciding with less canopy cover above the stream channel. The middle section of Bravo Creek and the lower mainstem North Fork Chetco exhibited the warmest daily water temperatures and the greatest diurnal fluctuations in stream temperature.

Were historic stream water temperatures, particularly in the summer, lower than the present? What have been the factors of change? What is the trend?

In 1940, most of the riparian zones contained contiguous cover of conifer and hardwood trees shading the stream. However, some had been fire-disturbed with some overstory and understory vegetation removed (refer to Section IV.4-Riparian Habitat). Low gradient, depositional stream channels may historically have had different dimensions than today; streams were likely narrower and deeper, and connected to a floodplain. If so, water moving downstream would have received less solar heating, and may have exchanged with and replaced bank-stored water in lowland alluvial reaches. This effect would act as a heat pump, removing heat from the stream in a down valley direction (Beschta 1996).

Historic and recent data suggest that *one* baseline or "reference condition" for seasonal maximum stream temperature is less than 64 °F. This was based on mainstem and tributary temperature data taken mid-day during summer and would apply only to unharvested segments or recovered fire-disturbance segments that contain >50% canopy closure. A higher reference condition is possible in segments that are not recovered from more severe stand-replacement fires.

Data (spot-check) taken from Bravo Creek in August, 1972 illustrates the baseline or "reference condition" for stream temperature. Examination of historical air photographs of the upper Bravo Creek drainage (CB GRIZ - 1969 and 1970; and C.S.B 1940) showed a fire-disturbance vegetative landscape (in un-harvested areas), with large conifer trees concentrated in riparian areas, and hardwood species dominating the riparian understory and upland areas. The 1940 and 1970 aerial photos showed that these large trees and associated vegetation provided 50-75% canopy closure over the stream channel. By 1970, timber harvest in Bravo Creek was concentrated in the downstream sections of the drainage (Sections 2, 3, and 9, T.40 S.,R.13 W.). Photos showed that where large conifers and other vegetation were harvested from the riparian area, the stream channel was visible under a 0-25% canopy closure. In the harvested area, mid-afternoon water temperatures in Bravo Creek reached 76 °F., while water temperatures in unharvested areas upstream were 64 °F. Some of the increase could be due to increasing channel width downstream, but this factor is not likely to account for the 12 °F increase in a distance of two miles.

Table IV-2 Comparison of Historical and Recent Summer Stream Temperatures. Data was obtained from a small set of point observations during a habitat survey in 1972-82, and from continuously recording water temperature monitors in 1994 and 1995.

	Historical Point Observation			**Continuously Recording Thermographs Range in Daily Maximum Temperature**		
Location	Date	Time	Water Temp.	1994	1995	Comparative Period of Record
NFC near Mayfield Creek	6-18-70	10:15 AM	60	56-60	52-56	third week in June
NFC near Mayfield Creek	9-15-82	1:15 PM	64	57-67	60-68	first week in Sept.
Bravo Cr. in Sec. 2 (site 2)	8-8-72	4:15 PM	67	68-71	62-75	first 2 weeks in Aug.
NFC at bridge above gorge	10-5-82	10:00 AM	54	-	52-59	first week in Oct.
Bosley Creek (site 3)	6-18-70	12:10 PM	55	58-62	50-55	third week in June

Available data suggests that there probably have not been significant changes in stream temperature patterns since the early 1970's. The aerial photography record showed that by 1970, a significant portion of the riparian canopy had already been clearcut harvested.

Are there processes affecting dissolved oxygen levels within the analysis area? If so, identify the processes and what streams are affected? What were historic stream oxygen levels?

The amount of oxygen dissolved in water can affect water quality and aquatic habitat. The solubility of oxygen in water is inversely proportional to temperature and directly proportional to atmospheric pressure. Most tributary streams are at saturation for their given elevation and temperature, because of stream tumbling and aeration, except for low stream flow periods. Dissolved oxygen levels may be reduced due to microbial decomposition of organic matter, known as biochemical oxygen demand. During late summer/fall, when flows are low, dissolved oxygen may fall below saturation due to the addition and decomposition of leaf litter from riparian forests (Taylor and Adams 1986).

Although no measurements have been recorded, dissolved oxygen in lower North Fork Chetco in the gentle gradient stream reaches probably declines to low levels during late summer low flow. Decomposition of algae in these valley bottom stream types may be depressing oxygen levels.

Although dissolved oxygen levels fluctuate with the seasons, it is thought that historic levels were seldom below saturation. Factors including decreased stream temperatures, lack of algae, less hardwood detritus, and narrower and deeper streams storing larger volumes of in-channel water, are thought to be characteristics that prevented significant oxygen reductions in stream water.

Little information is available to know if oxygen depletion is a currently a problem in the analysis area. The Non Point Source Assessment (ODEQ 1988) indicates dissolved oxygen is a moderate problem for the North Fork Chetco.

Are there processes contributing to fecal coliform levels within the analysis area? If so, identify the processes and what streams are affected? What were historic conditions?

The City of Brooking’s has recently been spraying sewage sludge in upland areas on private lands. These sites are well away from stream channels and is not expected to be contributing bacteria or pathogens to streams. There is very little human occupation in the analysis area, except for some residences along the Gardner Ridge and Lewis Roads.

Beaver are notably absent from the analysis area and, therefore, coliform bacteria from this species is not expected. There is not enough information to formulate a reference condition**.**

What are the influences and relationships between water quality and other ecosystems processes in the analysis area?

<u>Relationship of Turbidity to Floods, Landsliding, and Sediment Delivery/Routing</u>
The Non Point Source Assessment (ODEQ 1988) indicates turbidity, sediment, and dissolved oxygen as a moderate problem for the North Fork Chetco.

Landslides are the most important process in delivering sediment to streams in the analysis area and decreasing water quality. From a calculated landslide rate for the period 1940-1992, the Cassidy drainage is the most sensitive at 19 slides/ 1000 acres. Although the landslide rate is the highest of all drainages, the sediment transfer index is relatively low. This could mean that some of the slide materials are in storage as debris fans or terraces or delivered slide volumes are lower. The Bosley, Lower Chetco, and Middle NFC drainages fall into the second most sensitive landslide rate class with 9 to 11 slides/1000 acres. These drainages have high sediment transfer and sediment is routed through the drainages quickly in response to storms. Sediment may be moving in waves through the North Fork Chetco and out to the main Chetco River, estuaries, and eventually, the ocean. Landslide frequency peaked around 1970, and recent slide incidence more closely matches a pre-harvested condition (refer to Section III.5-Erosion Processes). Therefore, an improving trend for water quality is suspected. The November 1996 flood was the second highest on record in the analysis area and occurred without appreciable sliding. This seems to be further evidence that the analysis area is recovering with the regrowth of forest vegetation. Poor water quality, indicated by turbidity, is still high during storms, but clears quickly as the streamflow recedes several days later.

Runoff from roads and compacted areas as concentrated or overland flow or ditch runoff is causing erosion and is the second most important process in decreasing water quality. Bosley and Upper Bravo drainages have higher precipitation amounts, occasional snow, and are more sensitive to sediment delivery. No quantitative estimates have been formulated. Road decommissioning or improvement may reverse this trend.

Aquatic habitat can be degraded with movement of sediment materials. The sediment covers fish spawning areas, reducing oxygen to fish eggs and thus reducing populations. A constantly shifting streambed could make colonization by macro invertebrates or Pacific giant salamanders more difficult. Other stream processes that are affected include nutrient cycling related to the woody materials in the stream environment.

<u>Relationship of Water Temperature to Riparian Cover</u>

On BLM lands, the Aquatic Conservation Strategy and pattern of Riparian Reserves on intermittent and perennial stream channels will provide thermal control by shading the streams, except in cases of natural disturbance. Stream temperatures on intermittent streams on private lands in the analysis area will continue to be elevated where regeneration harvest is occurring, unless streamside shade is restored. Water temperature in seeps and springs are primarily dependant upon the underground soil/rock unit temperature.

<u>Relationship of Water Quality to Fire</u>

After higher intensity fires, where it burns across or backs down into stream channels, increased sediment delivery will result for several years. Channels could also release sediment stored behind LWD that is consumed. Channels could headcut and chronically access a new source of material until a solid stream base level is established. If the canopy is burned, stream temperature will increase and this affects water quality for a longer period of time, until shade becomes reestablished.

What is the management objective for water quality the analysis area?

The management objective is for clean, cool water that fully supports beneficial uses and meets or exceeds Water Quality Standards for the South Coast Basin, or as amended by basin wide standards or criteria referred to in "Oregon's Criteria for Listing Waterbodies" (ODEQ 1996a). It also includes ensuring that actions do not degrade water and meets Oregon's Antidegredation Policy. Soil and Water Conservation Practices, implemented as a Best Management Practice (BMP) design for a project will be carried out to meet Oregon's water quality goals. The *Northwest Forest Plan FSEIS* and *Coos Bay District's 1995 Resource Management Plan Appendix D* list many of these BMP's to be routinely used in management actions.

IV.2 AQUATIC HABITAT

The aquatic habitat is directly dependant upon the different types stream channels found within a watershed. To better understand this relationship, this Section will first discuss the types of stream channels found in the analysis area and the differing processes effecting them.

What were the historical conditions and trends of the stream channel types represented in the analysis area?

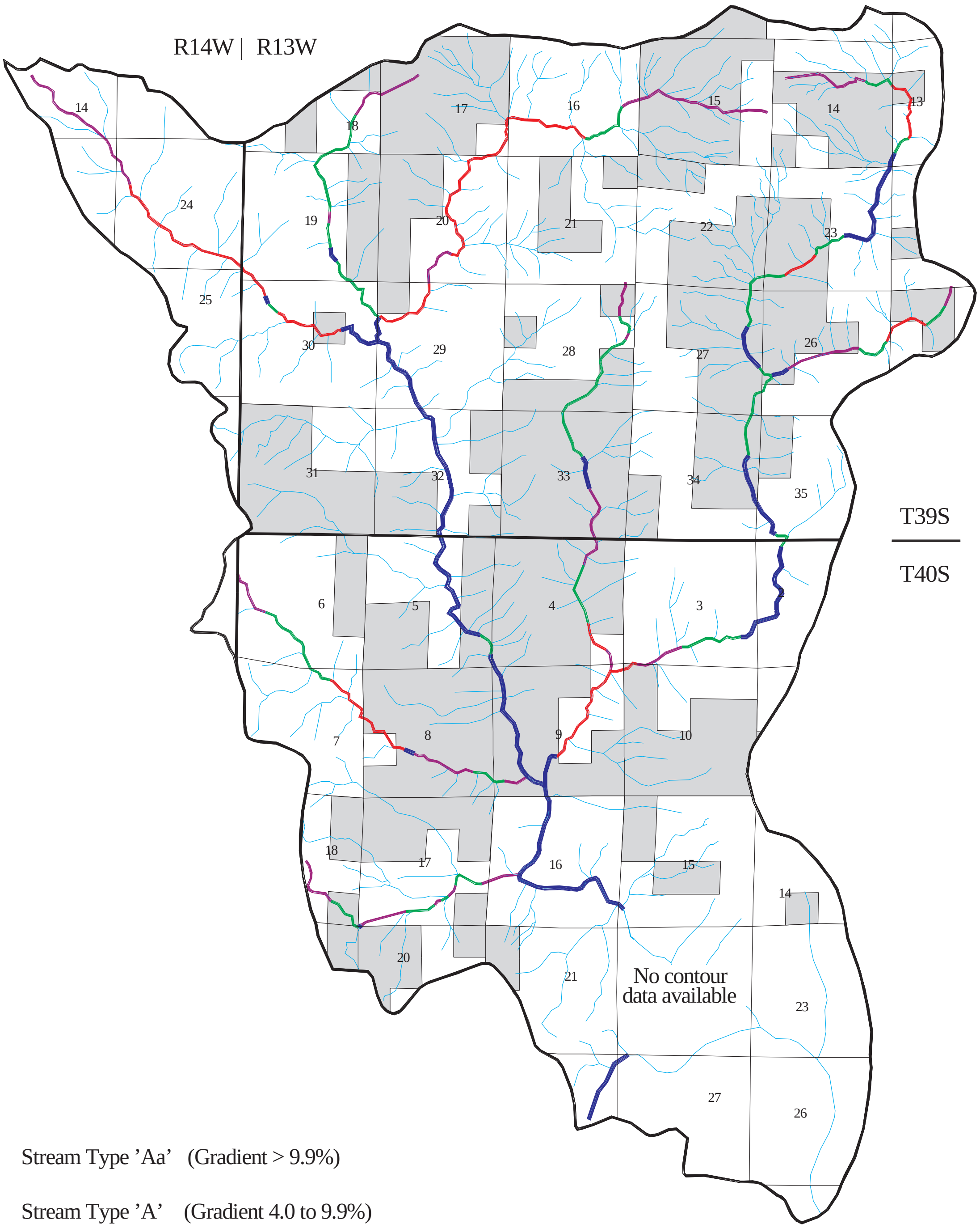
Stream types can best be described by stream channel similarities and differences. Rosgen classification system was used as a basis for comparisons (Rosgen 1994). Table C-1, Appendix C shows a brief outline of this classification system and hydraulic relationships, for stream types found in the analysis area. Figure IV-5 shows generalized Rosgen Stream Types for the North Fork Chetco analysis area.

<u>High Gradient Channels, Rosgen A and Aa Stream types</u>
These high gradient A (4-10%) and Aa (10%+) stream channels are usually 1st and 2nd streams. Streams in unmanaged timber stands are still representative of the historic condition.

<u>Moderate Gradient Channels, Rosgen B Stream types</u>
These moderate gradient (2-4%) transitional stream channels are usually 3rd and 4th-order streams. Few reference areas remain in the analysis area. This channel type contained steps formed by boulders and large woody debris (LWD) that are critical to maintain stream energy dissipation and prevent lateral adjustment and bank-cutting. Embedded LWD spanning the channel creates low velocity flats onto which sediments are deposited for long term storage.

<u>Low Gradient Channels, Rosgen C Stream types</u>
These low gradient (<2%) stream channels are usually 4th-order and greater streams. The probable historic condition for these channel types included streams that were narrow, unconfined by the stream bank at flood stage, and readily accessed adjacent floodplains during high flows. Their stream banks were stabilized by root masses including maple, cedar and other tree species. Although there may have been greater amounts of downed LWD in these channel types historically than at present, living trees were primarily responsible for maintaining bank

Figure IV−5 ROSGEN* Stream Channel Types



Stream Type 'Aa' (Gradient > 9.9%)

Stream Type 'A' (Gradient 4.0 to 9.9%)

Stream Type 'B' (Gradient 2.0 to 3.9%)

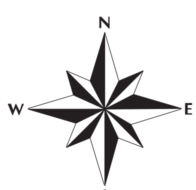
Stream Type 'C' (Gradient 0.0 to 1.9%)

(Above mainstems were modeled with some field verification.)

BLM Administered Lands

Other 1st and 2nd order streams are considered to be Type 'A' streams and were not modeled.

(* See classification system in Table C−1 of Appendix C)



Scale = 1:84,480

(.75" = 1 mile)

~ rosgen811.rtl ~

0.5 0 0.5 1 1.5 miles

1 0 1 2 km

stability. These channels dissipate energy by meandering and flowing over roughness elements along the banks and streambed.

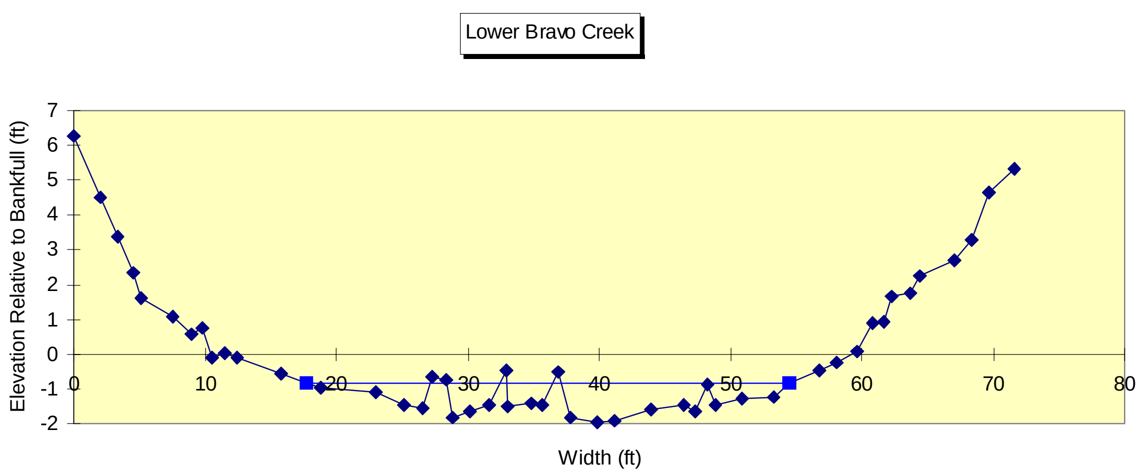
What are the current conditions and trends of stream channel types with respect to the sediment transport and deposition processes prevalent within the analysis area?

<u>Stream Channel Classification and Current Condition</u>

Each of the 11 drainages in The North Fork Chetco analysis area were inventoried in the field. During these inventories, typical cross sections of the channel were measured, pebble counts of the surface substrate of the channel bed were conducted, and longitudinal profiles of the channel gradient were created. Figures IV-6 through IV-8 show examples of the results. This data, when looked at together, gives important information about stream channel characteristics and aids in channel classification. Figures for additional drainages and the location of the sample sites can be found in Appendix C-2.

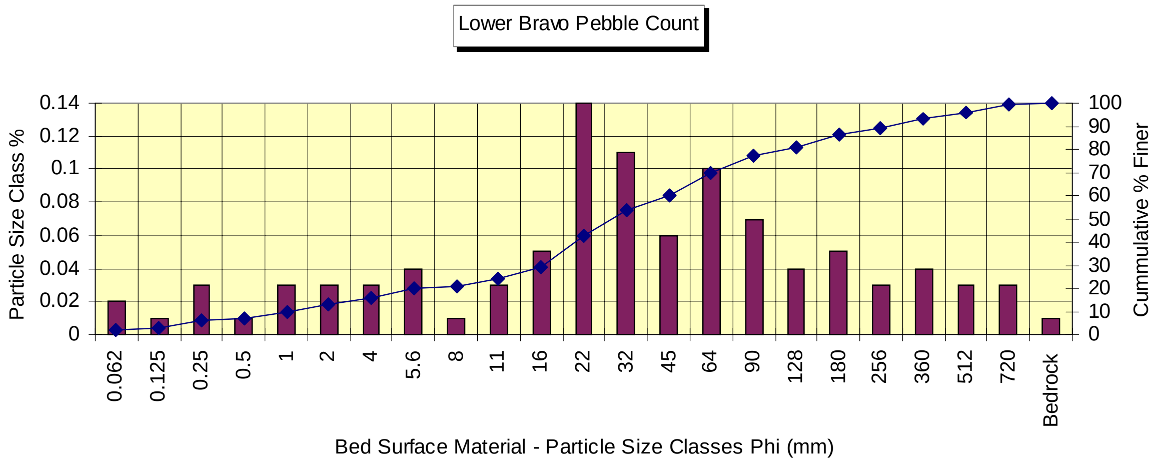
A typical cross section was measured with a tape and rod in the lower portion of each drainage in a low gradient (<2%), Rosgen B3c or C-type channel, at a site representative of the reach (Figure IV-6). The cross section contains information about bankfull width, depth and cross sectional area, and whether a floodplain is present above bankfull elevation.

Figure IV-6 Typical Cross-Section



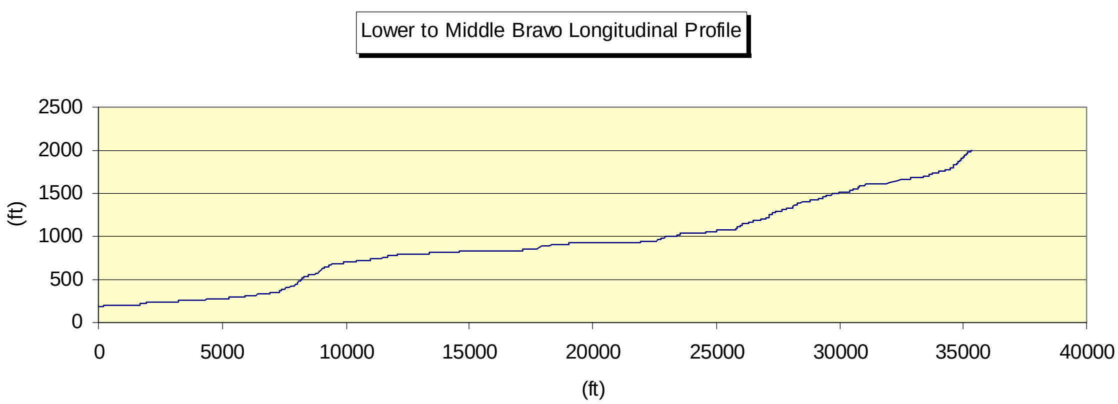
A pebble count of the streambed substrate was taken in the same area and covered riffle and pool sections (Figure IV-7). The sample is stratified within low gradient stream types. More replicate samples could be taken to determine confidence and trend of the data.

Figure IV-7 Typical Pebble Count Analysis



Longitudinal profiles of the stream channels were developed for each drainage by intersecting GIS contour and hydrography coverages (Figure IV-8). These profiles give a picture of the stream gradient which can be used to aid in stream classification.

Figure IV-8 Typical Longitudinal Profile



<u>High Gradient Channels, Rosgen A Stream types</u>
These are steep, V-shaped, erosional, relatively straight channels which lack a floodplain. Many are confined by bedrock channels and steep banks. About 124 miles (72%) of all channels in the analysis area fit this type. The main processes affecting these channels are infrequent landsliding and debris torrents. Review of past aerial photography indicates that although incidences of debris avalanches and debris slides into channels have increased from forest management, rapid movement down 1st and 2nd-order channels by torrenting has probably not been accelerated (refer to Section III.5-Erosion Processes).

A1a+ stream types are steep (>10%) stream types on bedrock and prone to the debris avalanche and shallow rapid debris flow process. The avalanches, debris slides and resulting torrents usually occur when concave hollows on headwalls above these channels are loaded with colluvium, soil materials and organic debris by natural or disturbance processes. When prolonged precipitation saturates thin soils, shear strength is reduced and failures are likely. This has been observed to be associated with the 5-10 year (or greater) recurrence interval storm. Shallow rapid debris torrents travel at 25-40 mph and are devastating to low-order channels. They are responsible for scouring bed and banks, carrying huge volumes of sediment, and leaving depositional fans at high angle, tributary junctions. This perpetuates the A1a+ channel type, by passing large debris, gravels, and sediments downstream to higher-order depositional stream types. This process occurs on an infrequent basis.

Moderate Gradient Channels, Rosgen B Stream types

These are moderately sloped, slightly meandering channels which either lack a floodplain or have very limited development. About 27 miles (16%) of all channels in the analysis area fit this type. Most B stream types are perennial. The main processes affecting these channels are the input of water, sediment and LWD from upslope channel segments, and some bank cutting, shallow rapid slides from adjacent hillslopes and entrenchment. Much LWD has been removed from this channel type, but energy dissipation is still occurring because of a high boulder component creating step/pools. Sediment is being accessed from streambanks, hillslope failures, and A-type channels upstream; it is temporarily stored behind obstructions or on localized flats where natural stream grade controls are present. Where stream slopes exceed about 2%, fine and coarse sediments are moving downstream during frequent flows. This stream type will not aggrade, even when sediment supply is high.

Low Gradient Channels, Rosgen C Stream type

This is a low-lying, meandering, wide and slightly entrenched to entrenched channel with a variety of substrates. About 21 miles (12%) of all channels in the analysis area fit this type. All C channels are perennial. These channel types are located lower in the drainages, along 4^{th} to 5^{th}-order streams and have larger contributing areas. This includes middle and lower North Fork Chetco, as well as some reaches of Bravo Creek. These stream types can easily be identified in longitudinal profiles shown in Appendix C-2. The main processes affecting type-C channels are the input of water and sediment from upstream channels (type-A and B streams), hillslope shallow rapid failures, and instream lateral and vertical adjustments through bank cutting and channel scouring.

This low gradient channel type is ordinarily a depositional area for fine sediments (sand size or smaller). However, pebble counts and observations indicate that type-C reaches in all drainages contain a low proportion (<10%) of bed material in this size category. The highest count of surface bed material sand size or smaller was 13% in the Lower North Fork Chetco drainage. It appears that high winter stream flows and flow velocities are quickly exporting smaller bedload materials (sand size and smaller) from all channel types within the analysis area. Pebble count diagrams for all survey sites are in Appendix C-2.

What are the natural and human causes of change between historical and current channel conditions?

Some effects on stream channels from forest activities do exist. There are approximately 216 stream crossings (road-stream intersections) in the analysis area. Some of these crossings have changed channel conditions locally by creating nickpoints, or have failed causing lateral migration of the channel. Some road ditches have extended the stream network of some low order channels. No quantitative estimates of channel extension or increase in runoff volume (due to roads) have been made. However, such increases are thought to have little effect on channel stability and aquatic habitat because stream channels here do not appear to be sensitive to runoff degradation by extra flow.

Shallow rapid hillslope failure directly adjacent to stream channels is a natural process that has been accelerated by clearcut harvesting. These failures have partially blocked and narrowed channels, or have caused lateral bank cutting. They are most pronounced in the valley bottom canyons along low gradient mainstem stream segments (refer to Section III.5-Erosion Processes). Because the mainstem streams are within canyon land forms that have resistant beds and upper banks, channel migration has been minimal.

Landslides affect sediment supply in streams in various ways. For example, if too few slides occur, the stream system may become starved for gravels and channels start to downcut or make lateral adjustments. Conversely, if the sediment supply is too great for the stream to handle, bar formation or aggradation may result.

The additional sediment that comes from harvest and road-related slides would have changed the routing process in comparison to a natural rate throughout the downstream sections. A portion of these same slides would have delivered as natural slides to the analysis area over time.

Examination of aerial photography for the 1950-1970 period reveal that slides contributed greater volumes of sediment. High instream water velocities during winter flows would have rapidly moved much of the fine sediment downstream and out of the analysis area. Coarse sediments have more resistance to movement and probably resulted in aggradation of some stream channels.

Given the added sediment from management activities, the removal of this sediment from high transport hazard channels must be analyzed for downstream impacts. Deposition of the sediment in high deposition hazard channels downstream could inundate flood plains of the lower gradient channel. This can affect both channel aggradation and stream habitat. Materials coming from road and harvest-initiated slides may only have affected the routing process in the Lower Bravo drainage. This drainage has a high deposition hazard and moderate transport index; thus, the movement of additional sediment may not have been routed as it had in the past. Bosley and Middle NFC drainage also have been affected by high numbers of landslides, but due to the ability of these streams to move large quantities of sediment downstream, they may not have had the deposition expected based on the deposition hazard rating.

Debris torrents are more infrequent than other landslide types in the analysis area (refer to Section III.5-Erosion Processes). Sediment is accrued by hillslope failures, bank undercutting and ravel. The A and B stream types, because of their steep gradients, rapidly transport coarse and fine sediment through them. Mid-slope roads acting as interceptors, channel landform constrictions, boulders, LWD, and debris torrent deposits can slow the routing process. Once a new equilibrium is established below obstructions, incoming sediments will be held in suspension during the frequent flows and moved downstream.

Type-C channels are low gradient, and the active channel dimensions are maintained by the frequent flows. Shallow rapid landslides from stream-adjacent deliver the majority of coarse and fine sediments in this stream type. Although the sediment supply is high, the surface streambed armor layer does not appear to be overwhelmed with fine sediments. A large percentage of coarse and fine sediments are near the bank-full stage at the margins of the active channel or absent. This implies sediment transport is flow limited rather than supply limited.

High volumes of water and discharges have caused some bank undercutting along the North Fork Chetco and Bravo Creek mainstems.

What was the historical condition and distribution of aquatic habitats throughout the analysis area? What is reference condition for aquatic habitat?

With the exception of forestry operations, the North Fork Chetco analysis area is virtually undeveloped upstream of Sections 14, 15, 23 and 26 of T.40 S.,R.13 W. Residential development in these sections is rural, sparse, and localized along the lower mile of the river and along Gardener Ridge Road. Late 19th and early 20th century human impacts to aquatic and riparian habitats included grazing, logging, small-scale road-building, fires, and mining. There were no splash dams in the analysis area or in the Chetco River. Farnell (1981) indicated that while the lower mainstem Chetco River was used for log drives around the turn of this century, such occurrences were small-scale and infrequent; none were recorded for the North Fork Chetco River. Later in the century, widespread timber harvest, road building, and fire suppression were common.

The earliest accounts of the Chetco River were provided by Lt. Francis R. Shunk of the U.S. Army Corps of Engineers in August, 1892 (U.S. Chief of Engineers (1893), as quoted in Farnell (1981)). This report noted that "After heavy rains the water rises to a 10-foot stage; at such times great quantities of logs, trees, and debris are brought down [the river]" and "There is plenty of timber - fir, spruce, myrtle, and tan oak." Skunk also noted that the population of the whole Chetco valley was not more than 100; there were no settlements other than the small town of Chetco at the mouth of the river, and very little commerce (U.S. Chief of Engineers 1893).

It is difficult to determine the historical condition of aquatic habitat because quantitative surveys and measurements of aquatic habitat prior to 1970 have not been located for the North Fork Chetco analysis area and probably do not exist (Appendix C Table C-4). However, reference condition for aquatic habitat probably best corresponds to areas of contiguous BLM ownership and with riparian reference condition sites listed in Table IV-7 (Section IV.4-Riparian Habitat).

Although these reference reaches have received little or no direct management, their respective aquatic habitats may have been altered from natural conditions by human impacts upstream (e.g., harvest or road-related landslides, debris torrents).

What is the current distribution and condition of spawning and rearing habitat for fish, including likely 'hot-spots'? How are these habitats maintained? How have human activities affected these habitats?

Distribution of Fish-Bearing Streams

The North Fork Chetco analysis area contains approximately 14 miles of anadromous and resident fish-bearing streams, and an additional 18 miles containing only resident fish (Figure IV-9). Total miles of anadromous fish distribution may vary yearly, based on habitat and flow conditions.

For anadromous fish, access to spawning and rearing habitat in the analysis area is thought to be limited by only *natural* barriers or habitat conditions:

- *Mainstem North Fork Chetco*: boulder canyon with multiple falls (Sec. 4-5)
- *Bravo Creek*: boulder canyon and falls (Sec. 3)
- *Ransom Creek*: high gradient cascades (Sec. 33)
- *Mayfield Creek*: high gradient (Sec. 17)
- *Cassidy Creek*: high gradient (Sec. 30)

For resident fish, access to habitat is primarily limited by natural barriers (high gradients or cascade/falls). In some streams, numerous passable obstacles cumulatively restrict the upstream distribution of fish. The only known human-caused barrier to fish migration is a culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16). Although resident cutthroat trout were observed upstream of the culvert, it is a barrier to upstream movement.

Aquatic Habitat Inventories

Formal aquatic and riparian habitat surveys in the North Fork Chetco analysis area began in 1972 and were conducted periodically thereafter (Appendix C, Table C-4). These surveys estimated stream substrate composition, pool abundance, shade, water quality (temperature, flow, clarity), fish species and abundance, and natural barriers. The surveys also noted numerous stream-side landslides and the presence of various aquatic and terrestrial fauna; beaver habitats were among those not noted. Debris jams were encountered infrequently during these surveys.

During the summer of 1995, the BLM conducted intensive aquatic habitat inventories (using ODFW methods) in the analysis area (ODFW and BLM, 1995). Data collected during these surveys was used to evaluate streams in relation to ODFW habitat benchmark criteria (Table IV-3). It is difficult to compare 1995 data with earlier surveys, because data were collected using different methods and for different objectives. However, adequate pool area (%), infrequent wood jams, clear water, and presence of stream-side slides were features noted in both the 1970's and 1995 surveys. (Location of the surveyed stream reaches found on Figure IV-10).

Figure IV−9 Anadromous and Resident Fish Presence

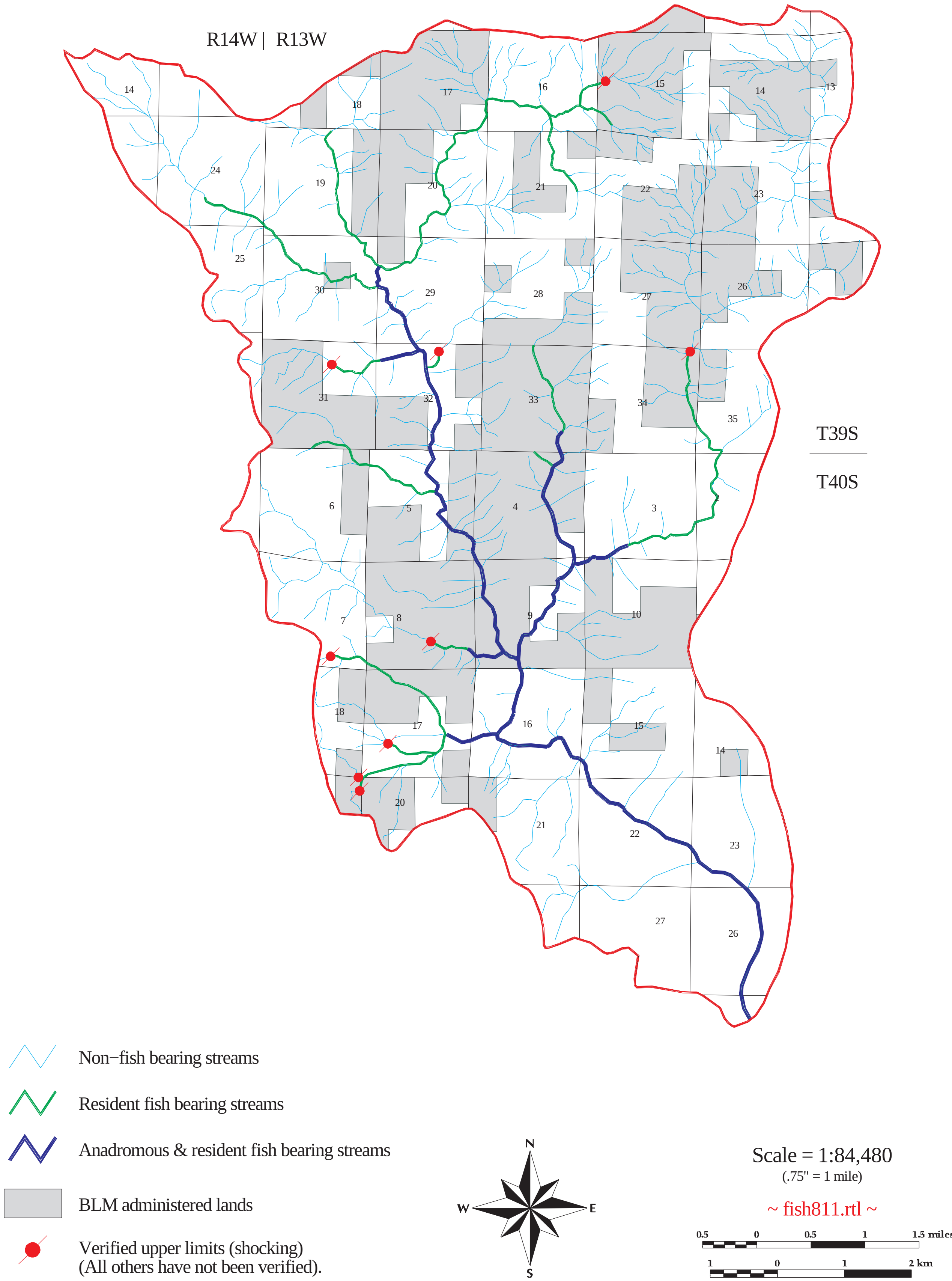


Table IV-3 Comparison of habitat conditions in North Fork Chetco and surveyed tributaries against ODFW Habitat Benchmarks as adapted by BLM reference site data (2). Data was collected during summer, 1995.

"Good" habitat conditions (2) based on values from surveys of reference areas with known productive capacity for salmonids and from the upper 65th percentile of values obtained in surveys of late-successional forests. "Poor" habitat conditions based on values associated with known problem areas and from the lower 25th percentile of combined data for each region. "Fair" conditions lie in-between.

= [white box] Good Habitat Conditions (2) [light grey box] =Fair Habitat Conditions [dark grey box] =Poor Habitat Conditions

Benchmark Criteria	North Fork Chetco River					Bravo Creek						Bravo Trib A
REACH	1	2	3	4	5	1	2	3	4	5	6	1
Pool Area (%)	32	58	45	33	26	29	21	43	36	39	39	28
Pool Frequency (# chan. widths/pool)	6.1	3.5	3.2	5.2	6.2	6.2	4.2	3.1	2.9	4.5	5.2	2.8
Residual Pool Depth (m) (scour pool depth minus riffle depth)	1.0	0.9	1.0	1.0	0.3	0.6	0.5	1.7	0.9	0.5	0.6	0.4
Width-to-Depth Ratio (in riffles)	39.3	21.7	19.6	37.2	18.8	25.3	16.2	30.0	15.6	26.3	20.3	11.1
Silt, Sand & Organics (% area in riffles)	6	3	2	1	0	0	0	0	0	0	0	0
Gravel (% area in riffles)	91	26	23	14	21	15	18	80	65	41	10	15
LWD (1) (pieces/100m)	4	2	5	6	28	3	6	15	24	23	8	27
LWD (1) (volume/100m)	1	2	10	6	19	8	19	46	21	17	21	16
"Key" Pieces LWD (#/100 m) (>60 cm dia. & ≥10 m long)	0	0.1	0.5	0.1	0.4	0.2	0.7	1.8	0	0.3	0.3	0
Riparian Conifers (2) (#>20" DBH/1000 ft)	30 (0)	0 (2)	0 (32)	0 (6)	0	0	0	x	0	30	122	30
Riparian Conifers (#>35" DBH/1000 ft)	30	0	0	0	0	0	0	x	0	30	0	0

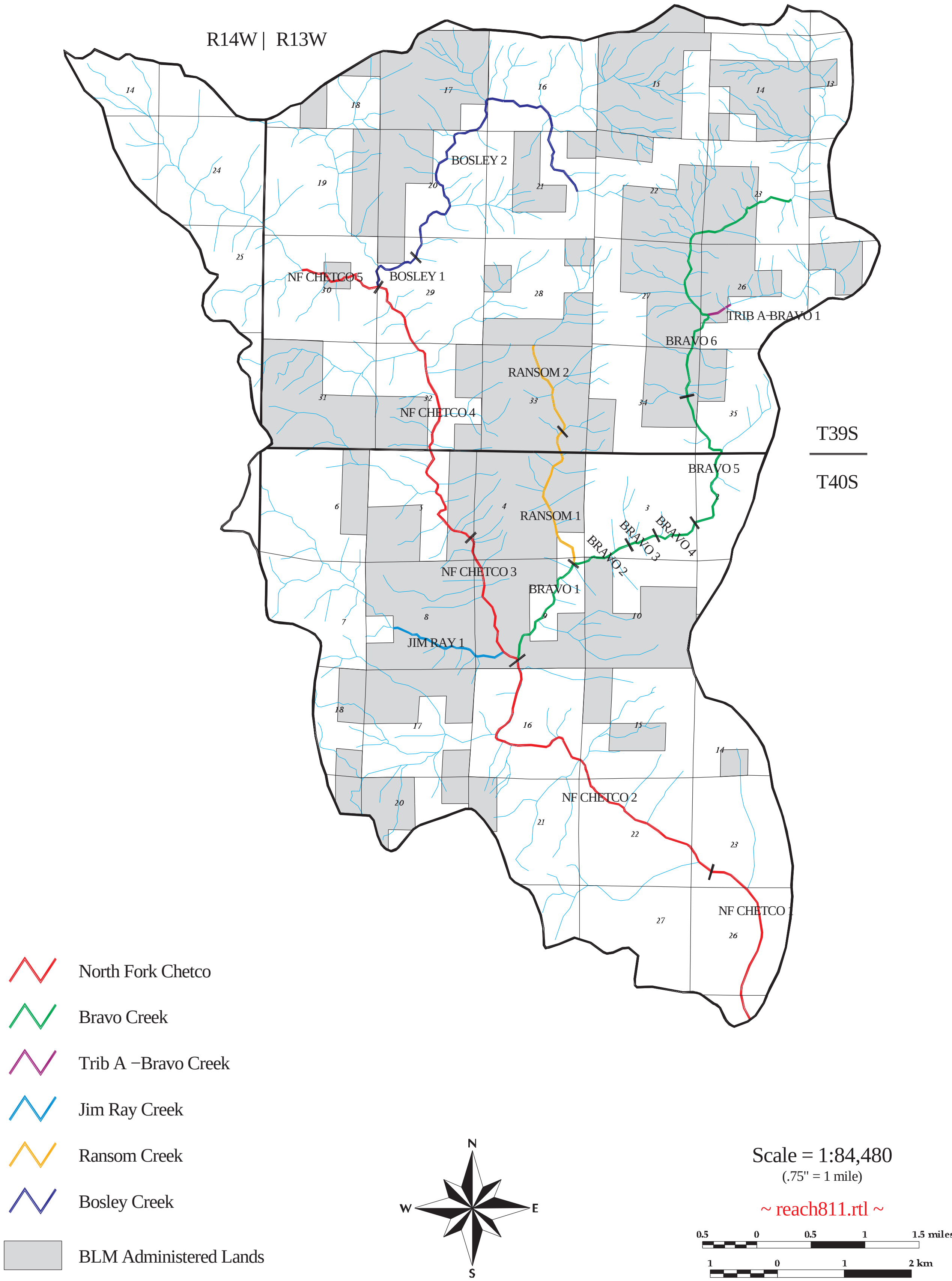
Table IV-3 (continued)

Benchmark Criteria REACH	Ransom Creek		Jim Ray Creek	Bosley Creek	
	1	2	1	1	2
Pool Area (%)	18	35	23	21	36
Pool Frequency (# chan. widths/pool)	6.6	6.3	3.9	6.8	4.8
Residual Pool Depth (m) (scour pool depth minus riffle depth)	0.4	0.4	0.5	0.6	0.4
Width-to-Depth Ratio (in riffles)	13.3	22.3	12.3	22.3	24
Silt, Sand & Organics (% area in riffles)	0	0	0	0	2
Gravel (% area in riffles)	7	29	39	13	11
LWD [1] (pieces/100m)	9	7	16	14	9
LWD [1] (volume/100m)	47	20	6	47	26
"Key" Pieces LWD (#/100 m) (>60 cm dia. & ≥10 m long)	1.2	1.0	0.1	1.7	0.8
Riparian Conifers [2] (#>20" DBH/1000 ft)	81 (30)	122 (30)	142 (15)	0	0
Riparian Conifers (#>35" DBH/1000 ft)	81	61	61	0	0

(1) LWD - minimum piece size 15 cm diameter, 3 m length; exception is rootwads with cut ends which may be <3 m long.

(2) Riparian Conifers - standards for "good" (data in parentheses) were based on reference reach data collected in the 1995 riparian inventory (BLM 1995; data on file in the Myrtlewood Resource Area, Coos Bay District BLM). This was a separate and more intensive inventory (counted all trees - 100% of reach length) than the ODFW survey (counted trees in transects - sampled 0.45% of reach length) (ODFW/BLM Aquatic Habitat Inventory Project, 1995). Where density was high, ODFW method overestimated conifer tree density by 27-800%; where density was low, ODFW method underestimated conifer tree density. Ransom Creek reaches 1-2, NF Chetco reach 3, and Bravo Creek reach 6, are considered old-growth "reference sites," and are representative of riparian stands in a natural disturbance regime.

Figure IV−10 1995 Habitat Inventory Stream Reaches



In addition to the aquatic inventories, the BLM conducted a more intensive riparian vegetation inventory adjacent to major streams, including the North Fork Chetco mainstem, Jim Ray Creek, and Ransom Creek (BLM, 1995). This was a separate and more comprehensive inventory of riparian vegetation that was *not* part of the ODFW aquatic habitat survey. This BLM inventory more accurately represented riparian condition, because 100% of riparian trees (within 100 feet of the stream) were counted; the ODFW method counted trees in transects, sampling only 0.45% of stream length. Conifer stem densities derived from this data are shown in parentheses along with the aquatic habitat data in Table IV-3. Where density was high, the ODFW method overestimated conifer tree density by 27-800%; where density was low, the ODFW method underestimated conifer tree density. (refer to Section IV.4-Riparian Habitat for additional discussion of riparian vegetation composition and reference sites).

Although management activities in the analysis area have affected habitat factors represented in Table IV-3 at specific sites over the last century, their cumulative impacts on the system's capacity to support fish populations analysis area-wide are unknown.

<u>Spawning & Incubation Habitat</u>

The quality of spawning habitat is affected by substrate composition, bedload movement, cover, and water quality and quantity. Successful incubation depends on extra- and intra-gravel chemical, physical and hydraulic variables (dissolved oxygen, water temperature, amount of fine sediment, etc.).

Although the location of specific 'hot-spots' are unknown, spawning and habitat surveys indicate that spawning for anadromous fish is concentrated along all Rosgen type-C and some type-B channels downstream of natural barriers (Figure IV-5). These channel types are generally 0-4% gradient, and have abundant gravel available for spawning. Chinook salmon, coho salmon, steelhead trout and Pacific lamprey spawn in reaches 1-3 of the North Fork Chetco River mainstem, downstream of a natural boulder canyon (Figure IV-10). Based on relatively high spawner densities, the lower 1.2 miles of the North Fork Chetco River could be considered a 'hot-spot' for spawning chinook salmon (surveys conducted since 1989; data on file at ODFW, Gold Beach OR). Although precise distribution is unknown, steelhead, sea-run cutthroat trout, and Pacific lamprey also spawn in North Fork Chetco reaches 4-5, in the first reach in each of Bosley, Bravo and Ransom Creeks, and in the lower sections of several unnamed tributaries to the mainstem. High densities of spawning steelhead have been observed within a 1.6 mile survey reach upstream of Road No. 40-13-5.1; this area may be considered a 'hot-spot' for spawning steelhead (surveys conducted in 1996-1997; data on file at ODFW, Gold Beach OR). Resident cutthroat trout spawn in many small streams throughout the analysis area, while resident rainbow trout are probably limited to reaches 4 and 5 of Bravo Creek. It is likely that the amount, quality, and location of available spawning habitat for all species varies yearly according to flow conditions (depth and velocity), and sediment delivery and transport.

Aggradation (deposition) and degradation (scour) of coarse sediments in spawning areas (Rosgen type-C channels) may be a concern in this analysis area. Low gradient, Rosgen type-C channels, are depositional areas, and could be prone to aggradation of coarse sediment if delivery from upstream processes exceeds the transport capacity of the reach. If such areas are used for spawning, the redds are more likely to be disturbed by flows that displace or bury the streambed material containing the redd.

Channel aggradation may contribute to intermittent channel drying (i.e., flow goes subsurface during the summer). A habitat survey of the North Fork Chetco conducted in Aug-Sep, 1982, described the first ½ mile as intermittent (i.e., a series of scour pools separated by dry gravel). The only pools present were small and associated with in-stream boulders and woody structure. This condition was also observed periodically during the 1990's. In addition, notes taken by U.S. Government surveyors on Sept 24, 1875, indicated that the North Fork Chetco River was dry near its confluence with the Chetco River in T40S-R13W-Sec 35, North ½ (Curry County Surveyor's Office). It is unknown whether this condition was a result of drought, aggradation of sediments, or a combination of factors. However, channel drying appears to be within the natural range of variability for the lower reach of this analysis area.

The rate of landslides and debris torrents increased after 1940 and peaked between 1955 and 1970. Although the analysis area appears to be recovering from these disturbances, the landslide rate remains slightly elevated from pre-harvest periods. It is presumed that the elevated rates by 1970 increased sediment delivery to stream channels and subsequent channel aggradation. Channel widening, braiding, bar construction, frequent stream bank failure, and pool filling by unsorted bedload are all indicators of an aggrading stream (Lisle 1987). Channel widening was observed from the 1970 aerial photos, while marginal pool depths, width/depth ratios, and riffle gravel values were indicated from the aquatic habitat inventory (Table IV-3). Although some channel recovery is evidenced by regrowth of riparian vegetation on exposed surfaces, there may be some question as to whether stream channels have transported all the excess sediment from the system so as to be considered fully recovered.

Fine sediment is not a limiting factor for egg incubation in this analysis area. Habitat inventories (1995) and pebble counts conducted in the analysis area indicated that gravel riffles in Rosgen C-type channels (assumed to be used as spawning habitat) contained a very low amount of sand, silt and organic matter.

<u>Rearing Habitat</u>
For a given number of spawners and seeding level, habitat conditions that set carrying capacity for rearing include stream productivity, abundance of certain habitat types (such as pools), and the quality of those habitats (i.e., complexity, water velocity and depth, and water temperature, turbidity, and chemistry). Fish rearing potential in the mainstem North Fork Chetco (reaches 1-4) and in Bravo Creek (reach 1) is limited for several reasons:

- high summer water temperatures (refer to Section IV.1-Water Quality)
- high winter flow and velocities, and low summer flow
- lack of complex pool habitat and large wood
- lack of deep pools
- hillslope constraints and shortage of floodplains

In general, pool area and frequency rate as fair to good throughout all inventoried reaches in the analysis area (Table IV-3). However, deep pools (>1 m) are rare, and residual pool depth in reference reaches (North Fork Chetco reach 3; Bravo Creek reach 6, and Ransom Creek reaches 1

& 2) rated fair to poor. In addition, nearly all of the pools present are scour pools; backwater, alcove, and beaver dam pools are very rare or absent in the analysis area. Scour pools, unlike backwater, alcove and beaver dam pools, are erosional at high flows and therefore do not provide suitable winter rearing habitat for most salmonids. In particular, juvenile coho salmon avoid high velocity (scour) pools at high flows and instead utilize backwater, alcove and beaver dam pools (Nickelson et al. 1992a and 1992b).

Structural complexity, in the form of wood or boulders, is an important feature of rearing habitat for salmonids, especially coho salmon and cutthroat trout. While abundance of boulders and boulder cover are high throughout the analysis area, structurally complex pools resulting from large wood, are limited or non-existent. For example, the average woody debris complexity score for most reaches surveyed in the analysis area ranged from 1.2-2.5 (1=low, 4=high); this corresponds to very low wood abundance, creating little or no habitat complexity or complex flow patterns. Such reaches are ineffective at providing cover at moderate to high discharge. Additionally, complex pools (with wood score $\geq$ 4) were non-existent. For this reason, overwintering habitat for coho salmon is probably limiting. However, because even "reference condition" riparian reaches (i.e., unharvested, mature and old-growth stands) have low abundances of large wood, lack of complex pool habitats may be a natural limiting feature.

Stream channel aggradation resulting from landslides can impact summer rearing habitat for resident and anadromous fish. For example, one landslide delivered high quantities of coarse, angular material to the channel, and temporarily aggraded the stream bed to a depth of six feet, for a length of 300 feet (ODFW and BLM 1995). This resulted in an absence of surface flow in the affected area during late summer, and the isolation of cutthroat trout and juvenile steelhead, all of which perished over a one week period as flow receded and water temperature increased. Such impacts are a primary concern in regard to road construction and timber harvest in unstable areas, especially adjacent to stream channels.

What effect have changes in channel morphology and riparian vegetation had on summer low flows?

Changes in channel morphology and riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Harr et al. 1979). Conversion from conifer to hardwood tree species such as tanoak or red alder, can actually decrease summer low flows from preharvest conditions because these species transpire more water during the summer low-flow period and acts as phreatophytic vegetation. No studies quantifying summer water loss in streams due to species conversion have been thoroughly studied (Beschta, 1996). It is not known what changes have occurred in low flow stream discharge during the years of intensive harvest (1950-1970), because of the lack of streamflow records. However, most low flow changes are thought to have been slightly elevated or beneficial to the aquatic ecosystem.

Morphological changes affecting the retention of low flows has been slight. LWD is not as important a contributor to pools and low flow pool retention, as other Coast range analysis areas because of the abundance of boulder and coarse substrates in forming and maintaining pools. However, C stream types in the analysis area need LWD to form and maintain quality pool depths.

Permanence of LWD in this stream type may be a problem, because high flows and few jam forming elements will allow this material to be swept downstream.

What are the influences and relationships between channel conditions and other ecosystem processes in the analysis area?

Channels are receptors of upslope processes. Much sediment was delivered coinciding with roading and harvest between 1940-1970. Two big floods in this period (1955 and 1964) no doubt contributed to landsliding (refer to Section III.5- Erosion Processes). Observations between successive aerial photograph years beginning in 1940 show sediment deposition and channel widening in the mainstem channels. Channel aggradation probably occurred during those years and may have persisted until the early 1980's. Eventually the stream flows were able to move much of the excess coarse sediments downstream.

Large scale fire, like the 1939 fire occurrence near Bosley Butte, allowed pathways for increased sediment delivery and may have elevated tributary flows for a period of time (refer to Section III.7-Disturbance Processes). Instream LWD removal, whether by timber salvage or fire may have allowed some channel adjustments (refer to Section IV.4-Riparian Habitat). Functions of large wood may be important in maintaining quality pools in Rosgen C channels.

What are the influences and relationships of aquatic and riparian habitats with other ecosystem processes (e.g., sedimentation, vegetation, large wood delivery, stream productivity)? How have human activities affected aquatic habitat?

Large Wood

Riparian reaches which best approximate "reference condition" (i.e., unharvested, mature and old-growth stands) have low abundances and sparsely distributed pieces and clusters of large wood (Table IV-3). Although direct comparisons are not possible due to differing data standards, the large wood abundances observed in the North Fork Chetco analysis area appear to be within the range observed in the remainder of the Chetco River (USFS 1997). Large wood may be naturally limited in the North Fork Chetco analysis area for two reasons:

- *Low Recruitment Potential*- Riparian stand-disturbing fires and stream-side landslides have created a highly variable mosaic of tree sizes and age classes, with very low levels of forest floor woody material (Table V- 3). Due to repeated fires, large wood abundance on the forest floor is rare (both in riparian areas and upslope), and it is unavailable for delivery to channels by landslides and debris torrents. In reference riparian reaches, large conifers >20 inches diameter are present, but in relatively low densities compared to analysis areas to the north (e.g., Coquille River). When present, large wood is usually a result of single trees or groups of trees delivered by windfall or from shallow slides immediately adjacent to the stream channel.

- *High Transport Potential* - The North Fork Chetco River is very efficient in transporting large wood, as well as sediments, downstream. Factors include high channel gradients, moderately confined channels with little floodplain (to dissipate energy) due to hillslope constraint, few land-form elements to anchor debris jams, and high runoff and flow velocities. During floods, large logs are more easily fractured into smaller pieces which are readily transported from the system.

While the disturbance regime may naturally limit large wood in the analysis area, wood abundance is probably substantially lower than it was before intensive harvest commenced in the 1940's, especially on private lands. The lower reaches of the mainstem North Fork Chetco River and most reaches along the other primary tributaries were harvested between 1940 and present (Figure V-2). These reaches are nearly void of large wood *and* large recruitable conifer trees from adjacent riparian areas.

Although "reference" reaches have received little or no direct management, conditions there may also be altered from natural conditions due to human impacts upstream (e.g., harvest or road-related landslides, debris torrents). Harvested areas deliver less large wood during debris torrents than would be expected under natural conditions. In addition, accelerated rates of debris torrents, (corresponding with peak harvest rates and floods) may have exported large quantities of woody material from some channels. Furthermore, salvage of large wood from stream channels is suspected on some BLM parcels that are accessible from private land. This was evidenced by close inspection of aerial photographs which showed the apparent removal of large logs from a debris torrent deposit between 1970 and 1976 (Bravo Creek). Aerial photos and ground inspections also indicated the presence of equipment trails in riparian areas which may have been used to salvage wood from the channel.

In the analysis area, large wood may be more important as a pool-forming element in type-C channels than in type-A and B channels. In this analysis area, type-A and B channels are generally controlled by boulders and bedrock, where these features are the primary pool-forming elements. In higher gradient channels, wood is often incorporated in jams and debris torrent deposits upstream of channel constrictions. When present as single pieces or in jams, large wood in these higher gradient channels effects local scour and deposition, but rarely forms backwater pools. In type C-channels, large wood pieces and jams can constrict flow, forming a variety of pool types, including backwater areas.

While large wood seldom offers complex rearing habitats in this system, the importance of woody material should not be discounted. Large wood serves as a substrate for macroinvertebrates, which in turn provide high quality food for fish and other aquatic species. In contrast to analysis areas to the north, gammarid amphipods are frequently noted in high densities. These amphipods are organic detritus processors, and are found on the substrate in association with woody material and accumulations of leaf and needle litter. Amphipods can occur in very high densities (10^3 per m^2), and serve as important prey for predatory fishes, such as salmonids (Thorp and Covich 1991). In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel diminishes the stream's capacity to retain the nutrients.

Stream Productivity

Stream productivity and fish production and survival are positively correlated (Meehan et. al. 1991, Konopacky 1984, McFadden and Cooper 1962) and abundance of food (macroinvertebrates) may override even cover in determining carrying capacity of juvenile salmonids in summer months (Christensen 1996). In the analysis area, management activities over the last century have reduced the input and retention of nutrients. Intensive road-building in the drainage has likely increased sediment supply, modified runoff, and altered substrate quantity and quality. In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel has diminished the stream's capacity to retain the nutrients. Additionally, alteration of riparian vegetation during timber harvest or road-building has removed a major food source for macroinvertebrates. Typically, removal of stream-side vegetation increases incoming solar radiation, causing concomitant increases in algae-dependent macroinvertebrate populations. However, fish production in this analysis area is not likely to increase because higher water temperatures are likely to outweigh benefits from the increased food supply. Finally, diminished fish returns to the analysis area have probably resulted in lower nutrient inputs associated with anadromous fish carcasses following the spawning season.

What is the current abundance, distribution, and condition of aquatic habitats for other aquatic and riparian associated species (e.g., herptiles, invertebrates, beaver), and how are they maintained?

Beaver

Beaver (*Castor canadensis*) within the analysis area are primarily bank-dwellers. The steep channels, flashy hydrograph, and lack of extensive floodplains and wetlands in this system limit the potential for persistent beaver habitat (i.e., beaver ponds). There has been virtually no trapping of beaver in the North Fork Chetco area for 20 years (ODFW 1997a), so these conditions may also limit beaver abundance.

Amphibians and Invertebrates

There have been no systematic surveys of amphibian or aquatic invertebrate habitat. In addition, there is little or no information on invertebrate or amphibian habitat or communities in small (1^{st}-3^{rd} order) perennial and intermittent non fish-bearing streams. Typically, habitat conditions important for aquatic amphibians and invertebrates (which spend some or all of their life in the water) are similar to that of fishes: water temperature and chemical composition, water velocity, stream productivity, amount of solar radiation, and physical variables such as substrate composition, habitat complexity, availability of cover, etc. (Hynes 1973, deMaynadier et. al. 1996, Nussbaum et. al. 1983). Invertebrate diversity is usually closely associated with substrate diversity and complexity of flow patterns (Christensen 1996). It is therefore assumed that natural conditions and management activities affecting instream habitat, flow patterns or riparian vegetation affect small stream communities in much the same way as the larger systems.

Macroinvertebrate community samples may be used to assess habitat quality indirectly (Rosenberg and Resh 1993). Limited data from macroinvertebrate samples collected at stations in North Fork Chetco, Bravo Creek, and Bosley Creek, 1993 through 1995, showed sample abundance, richness, evenness, and diversity were fairly high, indicating that water and habitat quality at sample sites was generally good (report on file in Myrtlewood Resource Area). Bravo Creek samples had substantially higher total abundance and EPT abundance than samples collected from the other sites, while richness, evenness, and diversity were not noticeably different. From these limited samples, it is difficult to generalize about macroinvertebrate habitat and communities throughout the analysis area because of tremendous variation inherent in macroinvertebrate samples and among microhabitat conditions across the analysis area.

Headwater Streams (1st and 2nd order)

Although most stream data collected for the analysis was within larger streams (4th order or greater), most of the stream miles in the analysis area are made up of small streams. Because small streams are so numerous and dissect the uplands, they are most likely to be affected by management. Persistence of these small-stream communities depends on stability of small stream channels (maintained by riparian vegetation, down wood), flow regime, and shade and detritus contributed by riparian vegetation.

Small streams are responsible for habitat quality and nutrient availability in larger tributaries downstream, and may act as refugia for aquatic and riparian-dependent organisms. Fish such as steelhead trout, Pacific lamprey and cutthroat trout are often found spawning and rearing in these small perennial systems. Small streams also provide habitat for a variety of amphibian and invertebrate species. They typically contain considerable micro-habitat diversity, producing rich biotic communities supported by allochthonous inputs from the adjacent forests. These small upland systems often contain plant and animal species not found in mainstems or in lower reaches (Tew 1971; Myrtlewood Resource Area, unpublished data on Sandy Creek, described in the Big Creek Watershed Analysis, 1997).

What and where are the human-caused obstructions to the movement and dispersal of fish or other aquatic species? What are the implications of human-caused barriers with respect to ACS objective #9?

Currently, only one culvert in the analysis area is a barrier to resident fish. Although resident cutthroat trout were observed upstream of the culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16), it is a barrier to upstream fish movement.

Roads and stream-crossing structures have been shown to function as barriers to the movement and dispersal of aquatic and riparian-associated wildlife species. Road crossings can inhibit fish passage because of blockage, deterioration, or poor design (outfall barriers, excessive water velocities, disorienting turbulence, flow patterns, etc.) (Furniss et al. 1995). Many perennial streams and riparian areas in the analysis area are intersected by roads and culverts. Because most culverts are placed above the natural stream bottom, they would preclude entry by non- or poorly jumping organisms (i.e., juvenile salmonids, sculpin, herptiles, crustaceans, molluscs). This condition also leads to a lack of natural substrate within the culverts, which may preclude passage by organisms which require roughness, cover, and a precise microclimate.

Some adult amphibians are capable of overland travel and may be able to by-pass problem culverts. However, research indicates that roads may also significantly inhibit the movement of some salamander species (deMaynadier and Hunter 1995). For a Southern Torrent salamander, which is rarely found farther than one meter from a stream (Blaustein et. al. 1995, Bury pers. comm., Applegarth pers. comm), a road would likely serve as a nearly impassable barrier. Because many riparian areas in the analysis area are intersected by roads, maintenance of aquatic dispersal routes may be important not only for aquatic species, but as dispersal routes for terrestrials as well.

Barriers to the passage of certain aquatic organisms may have serious impacts on ecosystem process in small streams above barriers. Amphibians and invertebrates make up a large portion of the biomass produced in aquatic systems, contribute to the maintenance of food webs by processing vegetation and leaf litter, and increase availability of nutrients to other organisms (Christensen 1996, Taylor et. al. 1996, Hynes 1970). The presence of man-made barriers is suspected of limiting the ability of aquatic species (other than fish) to access historic habitat. The capacity of aquatic and terrestrial species to access habitats and refugia may be an important factor in ensuring survival. Movement and dispersal may also be necessary to create and maintain genetic diversity. Formerly continuous populations that become reduced in size and isolated by barriers are more susceptible to genetic, demographic, and environmental changes (Shaffer 1982, Soule 1987).

What is the role of this analysis area within the larger 5th-field analysis area? What is the role of the 5th-field in the greater Chetco River system?

The analysis area comprises approximately 2/3 of the acreage in the 5^{th}-field analysis area (Figure I-1). The lower mainstem Chetco River and Jacks Creek are the only major drainages within the larger 5^{th}-field that were not included in this analysis. At a larger scale, three 5^{th}-field analysis areas make up the greater Chetco River system. It is difficult to quantify the contribution of the North Fork Chetco to these larger analysis areas due to lack of data at all scales. The North Fork Chetco analysis area will play an important role in maintaining salmonid survival within the 5^{th}-field, but its influence on the greater Chetco River system is less clear. These determinations were based on several factors:

- *Key Watershed* - The analysis area contains the North Fork Chetco Tier 1 Key Watershed, as designated by the Northwest Forest Plan and Coos Bay District RMP. The Key Watershed encompasses all drainages upstream from the confluence of Bravo Creek with the North Fork Chetco River, but excludes Mayfield Creek and drainages to the south. Public lands within the Key Watershed contain significant acreage of unlogged riparian areas (considered to be in ‘reference condition’ as well as a Late Successional Reserve habitat). However, some habitat elements including deep pools and large wood are missing. “Key Watersheds that contain poor quality habitat are believed to have the best opportunity for successful restoration and will receive priority in any watershed restoration program” (page B-19 in *Standards and Guidelines for management of habitat for late successional and old-growth forest related species within the range of the Northern spotted owl*).
- *Intensity of development* - North Fork Chetco and its tributaries receive less pressure from grazing, residential and agricultural development than lands in the Chetco River valley. The analysis area and the 5^{th}-field contain the majority of the intensive forest lands, while Late Successional Reserves and Wilderness make up the majority of the remaining Chetco River system. At 3.6 miles/m^2, road density in the 5^{th}-field is greater than in the remaining Chetco River, but it is lower than many managed analysis areas to the north (e.g., Coquille River). While the analysis area and the 5^{th}-field are less vulnerable to increases in peak flow (few acres of intermittent snow zone), it will receive more intensive forest management than the remaining

lands in the Chetco River system.

- *Habitat quality and abundance* - Low gradient, high value spawning habitat for anadromous fish (i.e., refugia) in the North Fork Chetco and in the 5th-field appears to be more extensive than in some other drainages within the Chetco system (reference Figure 8 - page 38, from Chetco River Watershed Analysis, Iteration 1.0). However, high quality rearing habitats for coho and chinook salmon are lacking.

- *Abundance of fish-bearing streams* - While the presence of numerous *natural* barriers in the analysis area limits the distribution of anadromous fish, those portions of the analysis area inaccessible to anadromous fish provide refuge for resident populations. The abundance of streams bearing both resident and anadromous fish increases the probability that some populations can perpetuate in the case of stochastic events.

What are the trends in aquatic condition, and what forces have the potential to reduce or limit the viability of key habitats or habitat elements?

The trend for all stream channel types in the analysis area is likely to be static or improving because: 1) the rate of landsliding and debris torrents observed between 1955 and 1970 has reduced to near-1940 levels, 2) abundant rough substrates (such as bedrock, boulders and cobble), and prevalence of constricted or constrained stream channels prevents much vertical or lateral adjustment in all stream types noted in the analysis area..

Aquatic habitat conditions on BLM lands are fair to good, while others are poor. Guidelines contained within the NWFP and BLM RMP provide protection for all aquatic and riparian habitats on public land through the system of Riparian Reserves and other land designations, including LSRs, ACECs, and Key Watersheds. Private lands, however, will continue to receive more intense pressure from logging and road building in and across riparian areas.

What are the management objectives for aquatic and riparian habitats in the analysis area?

Stream Channel: Attain a stable channel for all channel types. Stability means that the stream has the ability over time to transport the sediment and flow produced by the analysis area in such a manner that the channel maintains its dimensions, pattern and profile without either aggrading or degrading (Rosgen 1994).

Connectivity: Maintain and restore connectivity between and within streams for *all* aquatic species. When deteriorated or poorly designed culverts are replaced, they should be designed to allow *all* species access to historic habitat. Specifically, roads should be closed whenever possible and stream crossing culverts should be removed during road closure. If roads are to remain open, new culverts should be placed in contact with the stream bed and designed to replicate natural stream-bottoms where possible (i.e., to collect gravel throughout).

Emphasis on Processes: Restore the processes which create and maintain habitat for aquatic organisms. For example, the input of large wood and boulders onto floodplains and into stream channels via landslides and debris torrents is an integral part of creating and maintaining habitat for riparian and aquatic organisms. In some cases, the input of these materials via landslides and debris torrents is blocked by riparian roads and culverts. The removal (when possible) of riparian roads and/or avoidance of road construction in riparian zones helps restore or maintain inputs of large material. Large wood that has the potential to be delivered to stream channels should remain in the riparian area or be placed in stream for aquatic habitat, rather than removed.

Protect Refugia: Portions of the analysis area currently providing good-quality habitat for fishes, invertebrates, amphibians, and other aquatic species should receive priority in protection and restoration. In drainages where resident fish production appears high or where fish are distributed well into the headwaters (Mayfield Creek), and where stream ecosystem connectivity is relatively intact (all BLM lands, but primarily Bravo and Ransom Creeks), management activities should be designed to avoid fragmentation of habitat with barriers which may restrict access to habitat (i.e., roads and culverts).

Habitat Quality: “Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the target species” (Standards and Guidelines, B-9). Projects to restore or improve habitat quality should focus on restoring conditions appropriate for all aquatic organisms. A specific management objective for habitat quality is twofold: (1) meet or exceed ODFW criteria for “good” fish habitat, and (2) conduct habitat improvement projects which create and maintain a diverse array substrates to support diverse invertebrate and amphibian communities.

Cooperation: Opportunities exist for joint habitat-restoration projects with watershed associations, ODFW, and South Coast Lumber Company throughout the analysis area. Management should focus on establishing joint project-goals and sharing implementation and monitoring of subsequent projects.

Emphasis on Aquatic-Riparian Linkages: A dynamic linkage between riparian zones, floodplains, and streams is necessary for proper functioning of each element. Management activities should focus on creating and maintaining hydrologic and physical links between riparian and aquatic systems, such as: restoring natural vegetative assemblages including the presence of large conifer along streams, and placement of large wood that links stream channels to floodplains, and provides habitat for riparian and aquatic organisms.

IV.3 AQUATIC and RIPARIAN SPECIES

What aquatic and riparian-associated species are currently present, and how are they distributed?

Table IV-4 lists special status species that are obligate users of streams or riparian areas during their life cycle that are found or are likely found within the analysis area (refer to Section VI-Riparian Reserve Evaluation for additional riparian-associated species). Species are grouped by guild to emphasize functional relationships. Specific information about each species or group with special management status follows the table. Although there have been no known recent extinctions, population sizes and distributions have changed. For example, Oregon Coast coho salmon (Federally Threatened) are now virtually absent from the analysis area.

The North Fork Chetco analysis area contains approximately 14 miles of anadromous and resident fish-bearing streams, and an additional 18 miles containing only resident fish. Fish species include fall chinook salmon, coho salmon, winter steelhead, resident rainbow trout, anadromous and resident cutthroat trout, and Pacific lamprey. For anadromous fish, access to spawning and rearing habitat in the analysis area is thought to be limited by only *natural* barriers or habitat conditions (refer to Section IV.2-Aquatic Habitat).

Amphibians
Stream and Seep Associated Amphibians (Foothill yellow-legged frog, tailed frog, Southern torrent salamander) - Survey efforts for these species are limited to opportunistic observations. No systematic inventories have been conducted. Foothill yellow-legged frogs occur in Ransom Creek, Bravo Creek, and N. Fork Chetco River where habitat appears to be abundant (numerous course substrates, pool habitats). Tailed frogs occur in Ransom and Bravo Creeks. Southern torrent salamanders are known to occur along the North Fork Chetco River, Mayfield Creek, and Jim Ray Creek.

Beaver
There was a notable absence of beaver in the aquatic habitat surveys conducted since 1972. Beaver within the North Fork Chetco analysis area are primarily bank-dwellers. The steep channels, flashy hydrograph, and lack of extensive floodplains and wetlands in this system limit the potential for persistent beaver habitat (i.e., beaver ponds). There has been virtually no trapping of beaver in the North Fork Chetco analysis area for 20 years (ODFW 1997a), so these conditions may also limit beaver abundance.

Table IV-4 Aquatic and Riparian Species of Ecological Concern in the North Fork Chetco Analysis Area.

Species listed have either been found in the analysis area or incorporate the analysis area in their home range. [1]Species without specific legal or management status but are of concern due to role in ecosystem function. [2]At risk of extinction according to Nehlson et. al. (1991).

Species Group/Guild	Common Name	Scientific Name	Habitat Association	Pop'l Trend	Status
herbivorous	Beaver	*Castor canadensis*	Lotic, riparian	unknown	ecological concern[1]
insectivorous	Chinook salmon (fall)	*Oncorhynchus tshawytscha*	Lotic	decreasing	State Sensitive-Critical
insectivorous	Coho salmon	*O. kisutch*	Lotic	decreasing	Threatened State Sensitive-Critical At risk of extinction[2]
insectivorous/piscivorous	Coastal cutthroat trout	*O. clarki*	Lotic	decreasing	At risk of extinction[2]
insectivorous	Winter steelhead	*O. mykiss*	Lotic	decreasing	Proposed T&E At risk of extinction[2]
omnivore	Pacific Lamprey	*L. tridentata*	Lotic (channel margins)	decreasing	State Sensitive-Vulnerable
insectivorous/piscivorous	Pacific Giant Salamander	*Dicamptodon tenebrosus*	Lotic, lentic, riparian, springs/seeps	unknown	ecological concern[1]
insectivorous	Southern Torrent Salamander	*Rhyacotriton variegatus*	Lotic (channel margins), springs/seeps	unknown	State Sensitive-Critical
insectivorous	Dunn's Salamander	*Plethodun dunni*	Riparian, springs/seeps	unknown	ecological concern[1]
scraper/herbivore (tadpole) insectivorous (adult)	Tailed Frog	*Ascaphus truei*	Tadpole: Lotic Adult: Lotic, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable

Species Group/Guild	Common Name	Scientific Name	Habitat Association	Pop'l Trend	Status
collector-gatherer/omnivore (tadpole)	Red-legged Frog	*Rana aurora*	Tadpole: Lotic (channel margins) lentic, springs/seeps Adult: Lotic, lentic, springs/seeps, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable
insectivorous (adult)	Foothills Yellow-legged Frog	*Rana boylei*	Tadpole: Lotic (channel margins) Adult: Lotic (channel margins), riparian	unknown	Former Fed'l Candidate 2 Bureau Tracking
scraper-herbivore	Beers's false water penny beetle	*Acneus beeri*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Fed'l Candidate 2 Bureau Tracking
scraper-herbivore	Burnelli's false water penny beetle	*Acneus burnelli*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Fed'l Candidate 2 Bureau Tracking
insectivorous	Montane bog dragonfly	*Tanypteryx hageni*	Larvae: Lentic, springs,/seeps Adult: riparian	unknown	Bureau Tracking
scraper-herbivore	Denning's Agapaetus caddisfly	*Agapaetus denningi*	Larvae: small springs Adult: riparian	unknown	Bureau Tracking
collector-gatherer/ scraper omnivore	Redwood juga	*juga orickensis*	Larvae & Adult: Lotic - small spring-fed permanent rivulets to creeks; clear cold running water	unknown	Riparian Reserve Assessment Species

Fall Chinook Salmon

The biology and life-history of chinook salmon have been summarized elsewhere (see Groot and Margolis 1995). The fall chinook salmon of the North Fork Chetco River and the Chetco River system are classified as south-migrating (Euchre Creek through Winchuck River basins). ODFW spawning surveys have shown a decline in south-migrating stocks since 1960 (Coony and Jacobs 1997) which is thought to be a result of overexploitation during a time of poor ocean productivity (Coony and Jacobs 1994). Current population sizes in the North Fork Chetco River cannot be accurately measured but total Chetco River populations are estimated to be about 15,000 fish (USFS 1996a).

Adult chinook return to the North Fork from the ocean between mid-October and mid-January. Peak spawning is variable and has been observed from the second week of November through the last week in December. The majority of female spawners in the Chetco River are 4-5 year-old fish, while the majority of male spawners are 2-3 year-old fish (Nicholas and Hankin 1988). After emergence, chinook salmon juveniles are probably present in lower reaches of the North Fork through June, and then in the mainstem Chetco River and estuary through September. See Nicholas and Hankin (1988) for additional life history information on all chinook salmon stocks in Oregon.

Spawning surveys in the North Fork Chetco River have regularly been conducted for chinook salmon since 1989 (Table IV-5) (ODFW 1997b; Jacobs and Coony 1997). Chinook salmon use extends upstream to a boulder canyon barrier at approximately stream mile six. Based on high spawner densities relative to other drainages in the Chetco basin, the lower 1.2 miles of the North Fork Chetco River could be considered a 'hot-spot' for spawning chinook salmon.

Table IV-5 Peak counts on the North Fork Chetco River chinook spawning survey, 1989-1996.

Year	Peak Adult Count	Peak Jack Count
1989	209	21
1990	51	4
1991	93	6
1992	1	20
1993	180	25
1994	213	13
1995	129	4
1996	59	2

The survey begins at the mouth and extends upstream 1.2 miles to an unnamed tributary entering from the east. Area under the curve estimates can not be determined for most years.

Coho Salmon

Southern Oregon/Northern California coho salmon are listed as Threatened under the federal Endangered Species Act. Numbers of coho salmon in the Chetco River are extremely low and there is no distinct self-sustaining population. In previous times, some considered Chetco River coho salmon to be a fair sized run (OSWRB 1963, in USFS 1996a), although the portion of the run contributed by strays from other basins is unknown (ODFW 1997b). Spawning surveys are not conducted for coho salmon in this region and sightings of fish in the Chetco system during the last decade have been scarce. The presence of juveniles in neighboring Emily Creek in 1993 suggests one or two successful redds. There is little suitable coho salmon rearing habitat anywhere in the Chetco basin, and habitat in the analysis are is likewise limited.

Winter Steelhead

Chetco River steelhead, together with stocks from Cape Blanco to the Klamath River (inclusive), represent an Evolutionarily Significant Unit (ESU) that has been proposed for listing under the federal Endangered Species Act (the Klamath Mountains Province Steelhead). The Chetco River population is considered depressed (Nickelson et al. 1992c) and steelhead within this ESU are likely to become endangered in the foreseeable future (Busby et al. 1994). Average run size (1970-91) size is 5,100 total and 2,600 natural fish (49% hatchery) (Busby et al. 1994). Current population size, carrying capacity, and trends in escapement of adult and juvenile winter steelhead in the analysis area is unknown, but probably parallel that of the rest of the Chetco River population.

Winter steelhead migrate upriver with winter rains, and spawn in winter and early spring. Four months after spawning, juveniles emerge from the gravel and rear 2-3 years in the river before smolting. While in the ocean, few Chetco River fish are observed north of Cape Blanco (Pearcy 1992, in Busby et al. 1994), indicating that these fish are either south-migrating or stay in the vicinity of southern Oregon/northern California. Adults spend 2-4 years in the ocean before returning upriver to spawn. Up to 30% of the adults may survive to spawn a second or third time.

Spawning surveys for steelhead were conducted on the North Fork Chetco River in 1996 (Table IV-6) (ODFW 1997b). Although precise distribution is unknown, in steelhead spawn in North Fork Chetco reaches 1-5, in the first reach in each of Bosley, Bravo and Ransom Creeks, and in the lower sections of several unnamed tributaries to the mainstem (Figure IV-10). Based on high spawner densities relative to other drainages in the Chetco basin, the 1.6 mile survey reach could be considered a 'hot-spot' for spawning steelhead.

Table IV-6 Peak counts on the North Fork Chetco River steelhead spawning surveys, 1996-1997.

Year	Peak Steelhead Count	Peak Redd Count
1996		
Upper survey	22	9
Lower survey	20	21
1997		
Upper survey	54	16
Lower survey	34	4

The lower survey begins at the bridge for the 40-13-5.1 road (sometimes referred to as the 1000 Road) and proceeds upstream 0.8 miles. The upper survey begins at the upstream end of the survey and proceeds upstream another 0.8 miles.

Resident Fish

Resident and anadromous cutthroat trout and resident rainbow trout are distributed throughout the analysis area. For resident fish, access to habitat is primarily limited by natural barriers (high gradients or cascade/falls). In some streams, numerous passable obstacles cumulatively restrict the upstream distribution of fish. The only known human-caused barrier to fish migration is a culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16). Although resident cutthroat trout were observed upstream of the culvert, it is a barrier to upstream movement.

Resident rainbow trout in Bravo Creek are the apparent result of residualized steelhead fry releases in 1981-82. Suspected cutthroat/rainbow hybrids have been observed in Bosley Creek (BLM 1997) and Bravo Creek (BLM 1972). Mature male rainbow trout were also observed in the North Fork upstream from 40-13-5.1 road bridge in September, 1983 (ODFW electro fishing survey) indicating the presence of resident rainbow trout throughout North Fork Chetco analysis area.

Surveys conducted in May-June, 1997, point to several unique resident trout populations:

- *Mayfield Creek*- high densities of resident cutthroat trout that persisted upstream of numerous natural barriers and one culvert barrier into the extreme headwaters of the drainage.

- *Bosley Creek*- low densities of resident trout, but apparent cutthroat/rainbow hybrids; fish appeared to contain characteristics of both cutthroat and rainbow trout.

- *Bravo Creek*- resident rainbow trout above a natural boulder canyon, where a 1972 survey reported the absence of fish and recommended fish release. Rainbow were likely residualized steelhead from 1980 and 1981 releases of steelhead fry (ODFW, personal communication 1997a).

- *Unnamed tributary to NF Chetco (T39S-R13W-Sec. 31, 32)*- high density of large cutthroat trout (some $\geq$12 inches).

Other Fish Species

No data is available from which to assess the population status of other fishes (sculpins, Cyprinids, lamprey) in the analysis area. Anecdotal information suggests that the numbers of spawning resident and sea run cutthroat trout are below historic levels.

How have management activities and natural processes changed the abundance, distribution, and movements of these species or the character of their habitats?

<u>Amphibians</u>

Stream and Seep Associated Amphibians (Foothill yellow-legged frog, tailed frog, Southern torrent salamander) - Habitat quality for Foothill yellow-legged frogs appears high (lots of rocks, protected backwater pools areas during summer, moderate gradient). Nussbaum (1983) reported water temperature preference for yellow-legged frogs of 45-70 degrees F. Summer temperature monitoring found 7-day maximum temperatures slightly above 70 degrees on the lower North Fork Chetco River and on Bravo Creek which may limit habitat effectiveness. Torrent salamanders and tailed frogs require cold, clean water (low in silt). Blaustein et al. (1995) cite studies reporting temperature preferences of 46-54 degrees F for torrent salamanders and ≤ 72 degrees F for tailed frogs (< 50 degrees F for first-year tadpoles). In the analysis area, fine sediments are quickly transported out of the system during storms and generally do not accumulate in streams (refer to Section 4.1-Water Quality). Water temperatures, though, exceeded preferred temperatures for tailed frogs and torrent salamanders at each of the 5 temperature monitoring stations in the analysis area suggesting that water temperature may be limiting for these cold-water species. Flooding can decimate populations of larval tailed frogs (cited in Blaustein et al. 1995). The November 1996 flood (a 14 year flood event) could have reduced tailed frog populations in the analysis area.

<u>Beaver</u>

Beaver may be present in the lower portions of the North Fork Chetco river where the lower gradient and wider floodplains make for better habitat. Steep gradients and high, flashy winter flows probably limit habitat quality in the rest of the analysis area.

<u>Salmonids</u>

The effects of specific management practices and channel processes have been described in Section IV.2-Aquatic Habitat. In general, these practices directly affect fish production and survival when they alter the levels or timing of peak and base flows, route sediment into streams, simplify channels, limit habitat complexity, reduce food supply, and increase stream temperatures.

<u>Chinook Salmon</u>

A hatchery supplementation program for chinook began in the Chetco River basin in 1968 (1969 releases). Annual smolt releases averaged 371,000 between 1981 and 1994. Releases have since been reduced to 230,000 smolts from wild broodstock. No chinook smolts have been released into the North Fork, but there were several fry and/or presmolt releases in the North Fork between 1981 and 1992. Fry and presmolt releases were discontinued in the Chetco after 1993. Based on scale analysis, a large proportion (up to 50%) of the spawning population in the North Fork Chetco is composed of hatchery fish. This is probably due to the large hatchery program in the Chetco River and the lower river release sites used for smolts. The North Fork Chetco, along with neighboring Jacks and Big Emily Creeks, produces a high proportion of the chinook spawners for the basin, primarily because these drainages are situated lower in the basin, in closer proximity to the lower river release sites [hatchery and population information provided by ODFW, Gold Beach OR].

The following was excerpted from the Chetco River Watershed Analysis (USFS 1996a): "Since they [chinook] spawn in early winter in low gradient, gravel rich channels, their nests are very sensitive to mid- and late-winter storm damage. Redd success is suspected to be very low for mainstem spawners in all but the very mildest winters. Another critical in-river habitat consideration is warm lower-river peak water temperatures, which could negatively affect juveniles concentrated in the lower river prior to entering the ocean."

Coho Salmon

In the freshwater environment, the effects of management activities on salmonids may not be equal across all species. Resident trout and coho salmon may be particularly susceptible to limiting factors in the freshwater environment because they spend a greater portion of their life-cycle in freshwater than do chinook. Based on the relatively low survival rates from coho fry to smolt when compared to chinook (Sandercock 1991), it is apparent that the freshwater environment plays a major role in the fluctuation of coho abundance. In the North Fork Chetco analysis area, management activities over the last century have differentially affected habitat required by coho salmon for life-stages where highest mortality rates are typically observed. For example, survival during the critical period immediately after emergence is dependent on the availability of low velocity areas and the ability of coho fry to establish territories within them (Sandercock 1995). However, loss of large wood by harvest and salvage may have reduced channel-margin habitat and complex pools which provide refuge for fry. Elimination of these winter rearing habitat is proposed as a major factor limiting coho production in coastal streams (Nickelsen et al. 1992a).

Steelhead

A hatchery supplementation program for steelhead began in the Chetco River in 1969 (ODFW 1997b). Alsea stock was used through 1976; since 1977, Chetco stock have been used. The current supplementation program releases 50,000 smolts/year. There were some fry/presmolt releases between 1982 and 1991, but ODFW discontinued releases of steelhead fry in the Chetco River to avoid competition between hatchery and wild fish. No steelhead smolts have been released into the North Fork; however, fry were released at several locations along the North Fork (16,000 in 1981; 240,000-242,000 in 1985 and 1986), and in Bravo Creek, probably at the stream crossing on Road 40-13-2.0 (29,000 in 1980; and 21,000 in 1981).

Cutthroat Trout

Observations of resident rainbow trout and apparent cutthroat/rainbow hybrids indicate that hatchery supplementation with steelhead fry/presmolts may have had an impact on the genetic composition of resident cutthroat trout populations throughout the analysis area. Further information regarding releases between 1969 and 1977 and a genetic analysis of the current resident trout populations are necessary before the full impact of hatchery releases in the North Fork Chetco can be assessed.

Other Fish Species

Information has not been collected on non-salmonid species in the analysis area and it is therefore difficult to identify population trends and the major factors affecting abundance and survival. It is likely that species such as lamprey, sculpin and the Cyprinids in the analysis area have been particularly affected by management activities since these species occupy freshwater throughout most or all of their lifetimes.

Trends

Implementation of the Aquatic Conservation Strategy of the Northwest Forest Plan should improve habitat conditions for most aquatic and riparian-associated species on federal land. Because the

State Forest Practices Act provides limited protection during private timber harvest and road building activities, aquatic and riparian habitats will likely continue to fragment and degrade in portions of the analysis area. Protection of aquatic and riparian habitats on public lands and restoration initiatives on both public and private lands could assist in the recovery of anadromous and resident fish stocks, if ocean conditions and fish harvest management are concurrently favorable.

What are the management objectives for aquatic and riparian species in the analysis area?

Fish

The objective of management should focus on providing habitat conditions for self-sustaining populations of native anadromous and resident species.

For chinook salmon, which spend only a short time in fresh water, it is extremely difficult to conduct meaningful assessments of population sizes and trends at the watershed scale based on numbers of returning adults (spawning) because inter-annual and between-population variation are typically great (Healey et. al. 1984). Management objectives should therefore focus on *establishing and measuring* conditions known to maximize chinook production and survival (abundant, clean gravel/cobble beds for spawning and incubation, presence of marginal areas and complex pools for rearing) and *preventing or minimizing* conditions known to cause widespread mortality of eggs, alevin, and fry (instability of gravel beds, lack of velocity checks, sedimentation, high stream temperatures, etc.).

For coho salmon and steelhead trout, which may spend several years in the North Fork Chetco system, freshwater rearing conditions may play a dominant role in regulating abundance and survival. Management objectives should therefore focus on *establishing* and *measuring* freshwater rearing conditions known to maximize production and survival of these fishes (abundant, clean gravel beds for spawning and incubation, presence of low-velocity, complex in-channel and off-channel pools, good water quality and sufficient food supply) and *preventing* or *minimizing* conditions known to reduce survival and abundance (instability of gravel beds, sedimentation, low abundance of suitable rearing pools, high stream temperatures, etc.). Attainment of this objective means reaching minimum summer seeding (rearing) levels of approximately 1 coho parr/m^2 /pool (Nickelson et al. 1992).

Cutthroat trout spend their entire life-history in the analysis area. Specific habitat objectives for chinook and coho salmon and steelhead trout should benefit cutthroat trout as well. In particular, activities which increase habitat complexity will subsequently reduce interspecific competition between cutthroat trout and the dominant competitor, coho salmon. In addition, management should focus on maintaining connectivity to historic small-stream habitat and refugia for native trout (through the removal of barrier culverts and protection of small streams). Finally, introduction or release of steelhead above historic, natural barriers in the analysis area should be discouraged to protect resident trout populations above.

Little is known about the habitat requirements of other fish species in the analysis area, such as the sculpin, Cyprinids, and Lamprey. In general, management actions which maintain or improve water quality and increase habitat complexity and food abundance should benefit these species as well.

Other Species

Maintain populations of aquatic and riparian species and improve connectivity between populations. Discourage introduction of non-native species. See also Management Objectives for Terrestrial Habitats (Section V.2).

IV.4 RIPARIAN HABITAT

Where is the boundary of the riparian plant community, and what factors determine this boundary?

Riparian ecosystems are associated with streams and rivers, from intermittent headwater streams with no floodplains, to mainstem river reaches. These riparian ecosystems include floodplain and streambank plant and animal communities affected by the stream through water supply, flooding, or lateral transport of nutrients and sediments. The riparian ecosystem may also be defined as the area (with its associated processes) that directly affects the stream, including it's effect on shade and microclimate. Riparian forests also have profound effects on stream ecology, through the supply of sediment, leaf litter, and course and fine woody material. Therefore, depending on the function of interest, riparian zone boundaries can extend from 25 to >150 feet from streams in the analysis area.

Riparian vegetation boundaries in unharvested areas are often marked by the presence of mature and old-growth conifer trees which have survived repeated fires. This boundary (each side of the stream) ranges from less than 50 feet along small first- and second-order streams, to 150 feet along larger streams. Nearly 100% of the large wood recruited to streams from these areas is within 100 feet of the stream channel. Along lower gradient reaches (North Fork Chetco, reach 1), the riparian area extends to the edge of the floodplain, often greater than 150 feet from the bank-full channel. On many small headwater streams, including intermittent channels, seeps, and springs, the riparian area is often marked by dense mats of salal extending as few as 25 feet from the stream edge.

What are the riparian plant communities (plant associations) in the analysis area?

Riparian areas in the analysis area are composed of several plant associations, some of which are described in the *Field Guide to Plant Associations of Southwestern Oregon* (USDA Forest Service, 1996b). This publication includes a taxonomic system developed by researchers who compared numerous plant communities in the Siskiyou Mountains. The key organizes sites according to their potential natural vegetation if left undisturbed by fire, insects, etc. The system is based on the presence, absence, and abundance of plant species, as well as abiotic factors such as elevation and moisture. It is useful for communication among professionals, and for developing appropriate management guidelines. The following analysis was based on a riparian vegetation inventory (BLM, 1995) conducted within 100 feet of major streams, including the North Fork Chetco mainstem, Jim Ray Creek, and Ransom Creek.

The primary overstory species in unlogged riparian areas is Douglas-fir (range 5-50% cover; mean

15-20%). Western hemlock, western redcedar, and Port-Orford-cedar are absent along the larger streams, but are present in a few locations on the western edge of the analysis area. The reason for this is unknown, but it may influenced by repeated fires, lack of a proximal seed source, and the fact that the analysis area is near the southern end of the range for some of these species. Bigleaf maple, tanoak, and Oregon myrtle (California laurel) co-dominate the middle and understory of unlogged riparian areas (5-25% cover each). Red alder is generally found in a narrow band immediately adjacent to streams and on disturbed (logging, flooding or landslide) sites (5-30% cover). Previously harvested areas in main-stem reaches contain a mix of hardwoods in the overstory (red alder, bigleaf maple, tanoak, and Oregon myrtle), with no large conifers. Indicator shrubs and herbs in inventoried reaches include evergreen huckleberry (5-30% cover) and sword fern (25-50% cover). California hazel, oxalis, salal, rhododendron, and Oregon grape are also present, the latter three dominating the shrub layer in some seeps, springs, and perennial and intermittent first-order streams. In general, cover of salal and tanoak tends to increase as soil moisture decreases toward the headwaters.

The inventoried riparian plant communities correspond most closely plant associations of the tanoak series, generally in areas with higher mean annual precipitation and higher mean annual temperatures (page LIDE3-1 to 3-3 of USDA Forest Service, 1996b). Along larger streams, vegetation is best characterized by:

- LIDE3/PSME/GASH-VAOV2 (page LIDE3-34) TANOAK-DOUGLAS-FIR-EVERGREEN HUCKLEBERRY

The following may also apply:

- LIDE3/VAOV2-RHMA3-GASH (page LIDE3-36) TANOAK/EVERGREEN HUCKLEBERRY-PACIFIC RHODODENDRON-SALAL
- LIDE3/TSHE/VAOV2-RHD16 (page LIDE3-38) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY-POISON OAK
- LIDE3/TSHE/VAOV2/POMU (page LIDE3-40) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY/WESTERN SWORDFERN
- LIDE3/TSHE/VAOV2/POMU-RIP (page LIDE3-42) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY/WESTERN SWORDFERN *(Rip)*

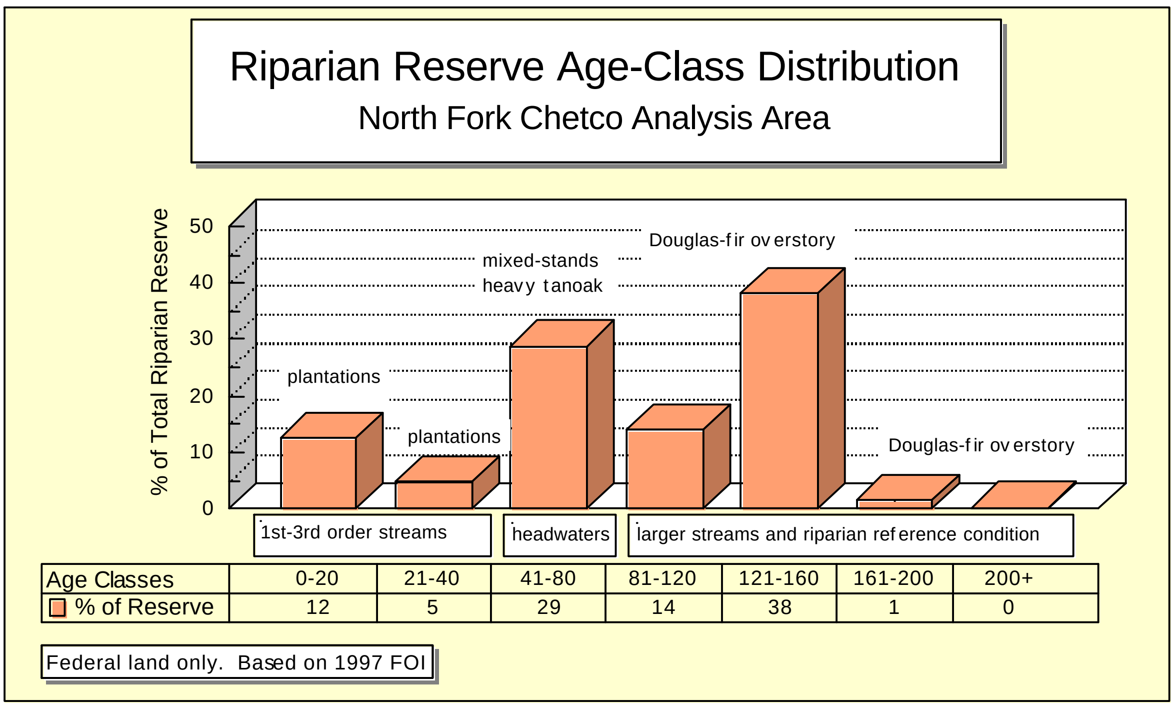
On smaller streams (perennial or intermittent), vegetation is often characterized by:

- LIDE3-PSME/GASH-RHMA3 (page LIDE3-30) TANOAK-DOUGLAS-FIR/SALAL-PACIFIC RHODODENDRON

What are the age-class distributions and seral stages of riparian vegetation?

On BLM lands, age class (FOI data) within Riparian Reserves can be used to approximate seral stage (Figure IV-11); this information is not available for private lands. FOI data is less accurate for the older age-classes (>80 years), because it classified some stands containing residual mature and old-growth Douglas-fir trees by the condition of the understory (i.e., dense tanoak stand). In addition, some riparian areas known to contain Douglas-fir 200-500 years old are not represented at all in FOI (e.g., Bravo Creek, Mayfield Creek). Therefore, some stands classified in Figure IV-11 as within the 41-160 year-old age-classes should actually be in the 161-200+ age-classes. No estimate of this acreage has been made, but it probably would not exceed 10% of the Riparian Reserves. Stands in the 41-80 year age-class are primarily located in areas that burned intensively in 1938, such as the headwaters of Bravo Creek and areas near Bosley Butte. They contain mostly tanoak, but some have remnant Douglas-fir.

Figure IV-11 Riparian Reserve age class distribution within the North Fork Chetco analysis area.



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Another analysis of seral stage distribution, based on a query of FOI for specific vegetation features, is shown in Figure V-4 (Section V.2-Terrestrial Habitat). No age-class information was compiled for private lands, although the riparian inventory indicated that many main-stem reaches are composed of a mix of mature hardwood species, with no large conifer in the overstory.

How do abiotic physical attributes of land affect the development and maintenance of riparian vegetation (slope, aspect, soil fertility)?

The North Fork Chetco area is characterized by convex side-slopes. This contrasts with concave side-slopes in basins to the north such as the Coquille River. Slope gradient is low to moderate near ridge tops (stable slopes) and high adjacent to stream channels (unstable slopes) (Figure III-3). This condition leads to frequent stream-side slides (as opposed to up-slope slides) The influence of these processes on vegetation is discussed under the following analysis question.

Southern and western-facing slopes receive more direct solar radiation and tend to be hotter, drier and more prone to fire. In the analysis area, these conditions would favor growth of xeric plant species such as rhododendron, salal, Oregon grape, poison oak, and tanoak. North aspect slopes generally receive heavy orthographic shading and retain more moisture during summer. These conditions would favor growth of mesic plant species such as red alder, bigleaf maple, Oregon myrtle (California laurel), salmonberry, vine maple, and oxalis.

Soil fertility and site productivity in riparian areas is generally higher than upslope due to increased moisture, deposition of organic material on floodplains, deeper colluvial soil, and nutrient exchange through groundwater.

Streams in the analysis area are generally topographically protected from wind, and in some areas, solar radiation. However, mature stream-side conifers within narrow buffers are susceptible to minor wind-throw (personal observation).

What are the prominent natural and human disturbance processes (e.g., fire, floods, landslides, logging), and how do they influence the pattern of riparian plant communities over the landscape through time (disturbance, succession)?

The primary natural disturbance processes affecting unlogged forests of the North Fork Chetco analysis area are wildfire, landslides, and floods. Human disturbances include logging, road construction, and human-set fires.

Regional patterns of disturbance by fire can be classified into three major time periods, but it is unclear as to what extent the analysis area was affected:

Prehistoric-	frequent low-intensity fires set by Indians and lightening, with relatively few large, hot fires.
Historic-	many large, hot fires set by miners and ranchers around the turn of the century
Recent-	effective fire suppression beginning in the 1940's.

Frequent fires in unlogged riparian areas are evidenced by scattered fire scars on live trees, charcoal in the soil, and the mosaic pattern of vegetation. Prior to fire suppression beginning in the 1940's, early Euro-American settlers set high-intensity fires which frequently spread from ridge to ridge, burning across large areas. Concurrently, low-intensity fires crept downslope, into and through riparian areas, without affecting the overstory riparian canopy. As a result, unharvested riparian areas adjacent to many small first- and second-order streams, as well as mainstem reaches, contain relatively high densities of large conifer trees compared to many upslope areas in the analysis area. These trees are available for snag and down log recruitment. Low-intensity fires in riparian areas generally set back the seral stage of understory shrub and hardwood trees such as tanoak, Pacific madrone, Oregon myrtle (California laurel) and big leaf maple, and leave the larger, more fire-resistant Douglas-fir. After low-intensity fires, these mid- story hardwood trees are not usually killed. Excepting alder, they sprout prolifically from their stumps, suppress conifer establishment, and reoccupy and dominate the middle and understory at these sites.

Shallow-rapid stream-side landslides occur naturally, and contribute to the mosaic of riparian vegetation. However, management activities (road construction and logging) account for an increase in landslide rate by three time the natural rate for this analysis area (refer to Section III.5 - Erosion Processes, for further discussion on landslide rates). Spatially and temporally dispersed stream-side slides were evidenced by numerous concave riparian slopes (slide tracks) with trees of varying ages established on them, or no trees at all in the case of very recent slope failures. The loss of the organic layer and top soil to landslides sets back plant succession and favors pioneer species. In reference reaches along Ransom Creek (reach 1, Figure IV-10) and the mainstem North Fork Chetco River (reach 3, Figure IV-10), landslides are colonized concurrently by both red alder and Douglas-fir. These species often successfully regenerate on stream-side slides, due to their ability to out-compete other vegetation on bare soils, and the reduction in competition from tanoak, which is often removed when landslides occur.

Flooding and high water tables favor establishment of a wide assortment of hardwood species. Red alder dominate within 25 feet of hillslope-constrained and high-gradient channels. Streams with more extensive floodplains, such as those in reach 1 of the mainstem North Fork Chetco (Figure IV-10), have a wider band of hardwood vegetation dominated by red alder and Oregon myrtle, but also contain bigleaf maple, Oregon ash, willow, cottonwood, elderberry, cascara, and salmonberry, among others.

Clearcut logging (often by tractor), road construction, and post-fire salvage of conifers, has set back the seral stage and altered the species composition of riparian vegetation on almost all private lands in the analysis area. Logging has resulted in the near-absence of mature Douglas-fir, higher abundances of red alder, and greater cover of sword fern (>70%) within 100 feet of North Fork Chetco River, reaches 1, 2 and 4 (Figure IV-10). In some instances, conifer are present in the understory of red alder; in other cases, well-stocked conifer plantations are within 100 feet of the stream. On BLM lands, riparian vegetation along most third- and higher-order streams has not been logged.

Logging, followed by the 1964 flood, resulted in frequent channelized debris torrents throughout the analysis area. The rate of debris torrents peaked in 1970, at 25% of the total number of landslides observed on the aerial photos (Section III.5-Erosion Processes). In torrented channels, stream-side riparian vegetation was removed, and sediment and logs were deposited on wider floodplains, and on flats upstream of channel constrictions. Most of these exposed areas have since revegetated with red alder and other hardwood species.

What riparian forest stands and stream channels represent reference condition?

Reference riparian areas contain the highest quantities of live mature and old-growth Douglas-fir trees which are available for snag and down log recruitment. Reference condition in riparian areas is indicated by frequent understory burns that leave mature Douglas-fir in the overstory. and a mosaic of various seral stages and hardwood communities in the middle story and understory. Hardwood species include tanoak, Oregon myrtle, bigleaf maple, and red alder. The abundance of *large* middle story hardwood trees in these areas may have resulted from the modern suppression of fires. The fire pattern is superimposed by a mosaic of stream-side slides colonized by red alder and Douglas-fir of various ages. More frequent and intense burns in some smaller headwater streams have resulted in early-seral communities (overstory and understory) that resemble up-slope areas (i.e., predominance of tanoak).

Riparian reference condition is prevalent in this analysis area, and is best approximated by BLM lands listed in Table IV-7, as referenced in Figure IV-10.

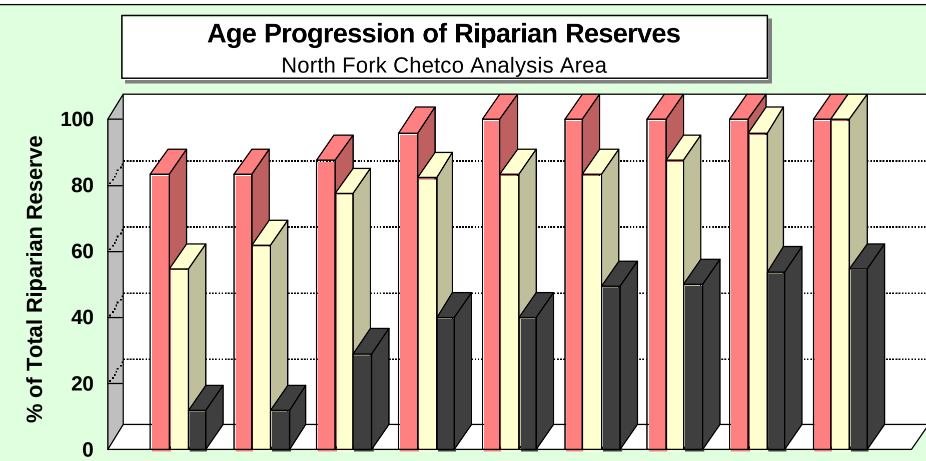
Table IV-7 Riparian reference conditions in the North Fork Chetco analysis area.

Stream Name	Location	Land Designation
NF Chetco River	Reach 3	ACEC; LSR; Key Watershed
NF Chetco River	1,000 foot reach of stream in reach 5	Matrix; Key Watershed
NF Chetco tributaries	T39S.-R13W-Sec. 31& 32 T40S-R13W-Sec. 6	Matrix; Key Watershed
Ransom Creek and tributaries	Reaches 1 & 2, and tributaries	LSR; Key Watershed
Bravo Creek and tributaries	BLM lands in reaches 5 & 6, and tributaries	Matrix; Key Watershed
Jim Ray Creek	BLM lands in lower part of reach 1	ACEC; LSR; Key Watershed, Matrix
Mayfield Creek	Isolated areas in headwaters, especially stands in the middle Mayfield Creek tributary in section 17	Matrix

What are the trends of the prevalent riparian plant communities and seral stages in the analysis area?

On BLM lands in the analysis area, a general stand-age progression of Riparian Reserves can be studied from Figure IV-12. Currently 55% of the Riparian Reserve system is in a mid- to late-seral condition, and within 30 years, 80% will reach that level. However, most of the 41-80 year-old age-class (i.e., the age-class that will move into mid- to late-seral within 30 years) contains tanoak-dominated stands. While some of these stands may contain suppressed or intermediate Douglas-fir, others may not contain a conifer component needed to supply future large wood and snags to the riparian ecosystem. Management techniques (i.e., silviculture or fire) could be used to initiate or accelerate conifer development, but further investigation into management options for these areas is needed.

Figure IV-12 Age progression of Riparian Reserves in the North Fork Chetco analysis area, based on 1997 Forest operations Inventory Data. Analysis assumes Interim Riparian Reserve widths are maintained.



Decade	2000	2010	2020	2030	2040	2050	2060	2070	2080
Stands =>40 years	83.47	83.47	87.52	96.07	100.00	100.00	100.00	100.00	100.00
Stands =>80 years	54.86	61.87	77.68	82.65	83.47	83.47	87.52	96.07	100.00
Stands =>160 years	12.03	12.03	29.15	39.98	39.98	49.51	50.28	53.86	54.86

Assumption: Interim riparian reserve widths are maintained.
Federal land only. Based on 1997 FOI

In unlogged, reference riparian stands (Table IV-7), the absence of low-intensity fires burning through the understory will result in a trend toward more large and decadent hardwood trees in the middle story and a diminished shrub layer. If fire were to reach this hardwood canopy, there could be a greater risk of conducting fire to the overstory Douglas-fir, resulting in a stand-replacement fire.

Young conifer plantations in Riparian Reserves (0-20 and 21-40 age-classes) are expected to retain relatively high densities of conifer as they age, but still contain a hardwood component.. On private lands, intensive management will result in a predominance of early- and mid-seral riparian areas (<80 years old) and young conifer plantations.

What are the influences and relationships between riparian vegetation and other ecosystem processes (e.g., large wood, channel stability, wildlife species, etc.)?

Large wood is supplied to stream channels by wind-throw of stream-side conifer trees, landslides, and bank erosion. While large wood effects localized scour and deposition, and serves as a substrate for macroinvertebrates (which in turn provide high quality food for fish and other aquatic species), channel stability in the analysis area is more controlled by bedrock and boulders than by large wood. The relatively low natural recruitment potential and high natural transport potential (due to channel geomorphology and hydrology), combined with effects of harvest and salvage, result in a low abundance and complexity of large woody structure available for aquatic habitat.

Harvest and salvage of riparian vegetation and down wood has resulted in reduced structural complexity in riparian zones throughout the analysis area. In addition to reducing the *amount* of wood inputs, management activities have changed the *nature* of inputs, especially on private lands. For example, down wood recruited to streams is now predominately hardwoods (which tend to be smaller and have a much shorter life span in the stream than do conifers). The predominance of hardwoods and brushy species in riparian zones previously dominated by conifers alters the nature and amount of nutrient inputs. Deciduous shrubs and trees typically contribute greater amounts of organic litter to streams than do conifers, and deciduous litter is often the preferred food source of aquatic shredders (Anderson and Sedell 1979). However, the beneficial effects of increased nutrient inputs from a hardwood-dominated riparian zone will not be realized if insufficient instream structure (caused by lack of large wood in the channel) prevents retention of these added nutrients.

Because fires burn less frequently and intensely in riparian areas, old-growth Douglas-fir forests and large snag/down log habitats are more common in riparian areas (on BLM land). In the analysis area, these habitats often occur as narrow strands through upland areas that are otherwise dominated by hardwoods and earlier seral stages. These corridors of late-successional habitat provide corridors for wildlife movements, as well as provide refugia for repopulating upland areas as they progress into mid- and late-successional stages. They also provide large snag and down log habitats adjacent to streams which are used by many wildlife species. However, these corridors are fragmented by long reaches of much younger riparian stands which lack large conifer trees, logs and snags. Fragmentation and disruption of riparian vegetation reduces its utility for migration and dispersal of fish and wildlife. (refer to Section V-Terrestrial Ecosystems, for additional discussion.)

Is there adequate riparian canopy closure to maintain desirable stream temperatures for aquatic organisms?

Depending on stream aspect, channel width, and degree of valley wall confinement, direct solar radiation along some smaller streams can be effectively blocked by hardwood vegetation or topographic shading. Since 1970, hardwood vegetation (and shade) has re-established on debris torrent tracks and on channels exposed following harvest and flooding between 1950 and 1970. Along wider streams, such as the mainstem North Fork Chetco River and Bravo Creek, tall conifer trees are often also required to provide adequate stream shade to maintain the natural range of stream temperatures. Lack of riparian canopy closure may be impacting stream temperature on lower Bravo Creek, lower mainstem North Fork Chetco, and portions of Mayfield Creek. All BLM lands along major streams and tributaries, and private lands on Bosley Creek, generally provide adequate shade to maintain stream temperature. On BLM lands, shade is lacking on first and second-order streams within timber sale units harvested since 1985. Adequate information is lacking for Cassidy Creek, upper NF Chetco, and Mayfield Creek. (Refer to discussion of stream temperature in Section IV.1-Water Quality.)

Is there adequate potential for recruitment of down wood to streams and riparian areas?

Most BLM-administered lands (i.e., reference reaches) contain an adequate source of large conifer trees that can be recruited to stream channels, while most private lands do not. Because private lands will likely continue to be managed intensively for forest products, large wood recruitment is likely to remain low.

What are the management objectives (desired conditions) for riparian vegetation in the analysis area?

The management objective for riparian vegetation is fourfold:

- Re-establish historic vegetation assemblages and connectivity to the extent possible throughout the analysis area. Riparian areas adjacent to mainstem channels would have a mixed hardwood/conifer overstory, or a overstory dominated by mature and older conifers with a mix of native hardwoods in the middle and understory. Red alder would be present within a narrow band in the zone of hydrologic interaction between the stream channel and riparian area, and present with young conifers on landslide-disturbed sites. The species composition and cover of understory shrubs and forbes would vary with site conditions.

- Re-establish natural/historic fire interval including the presence of low-intensity understory burns in riparian areas.

- Re-establish shade to maintain and recover water temperatures along the mainstem North Fork Chetco River and Bravo Creek.

V TERRESTRIAL ECOSYSTEM

V.1 VEGETATION

What is the current abundance and composition of the plant communities present in the analysis area?

The analysis area lies within the Mixed-Evergreen (*Pseudostuga*-Sclerophyll) forest zone, also referred to as Douglas-fir/hardwood forests. The landscape is generally forested with an occasional meadow. The trees comprising these forested stands are predominantly Douglas-fir and tanoak (*Lithocarpus densiflorus*), both of which are judged to be climax species (Franklin and Dyrness 1973). Other species, such as knobcone pine, madrone, myrtle, and bigleaf maple are present. Good discussion on this vegetation community are found in Franklin and Dryness (1973) and Whittaker (1960).

Douglas-fir/hardwood

The Mixed-Evergreen zone is "one of the most diverse and complex forest regions of western North America" (Agee 1993). Over 85% of the analysis area contains varying stages of this Douglas-fir/hardwood plant community. In mature stands, Douglas-fir occupies the dominant position in the canopy and supplies from 40 to 60 % of the overall cover (Atzet et al. 1996). The lower canopy position is occupied predominately by tanoak, supplying most of the remainder of the cover. Madrone and chinquapin are also present in the lower canopy, but generally occupy less than 10 % of the cover. Myrtle, bigleaf maple, and red alder are more common closer to riparian areas (refer to Section IV.4-Riparian Habitat).

<u>Plant Associations</u>
This community is composed of several plant associations as described in the *Field Guide to Plant Associations of Southwestern Oregon* (USDA Forest Service, 1996b). According to visual observations and information from the Guide, the predominant plant association is;

- LIDE3/VAOV2-RHMA3-GASH (page LIDE3-36) TANOAK/EVERGREEN HUCKLEBERRY-PACIFIC RHODODENDRON-SALAL

  This association is usually indicative of dry, less hospital sites. Differences in moisture regime within this association can be determined by the presence of sword fern (more moist) or salal and beargrass (more dry) (USDA Forest Service, 1984).

In addition, one small area west of Morton Butte contains canyon live oak and can be classified as;

- LIDE3/PSME-QUCH/BENE2 (page LIDE3-22) TANOAK-DOUGLAS-FIR-CANYON LIVE OAK/DWARF OREGON GRAPE

  This site contains shallow soils with exposed rock outcrops.

Other associations may be present, but are expected to be a minor percentage.

<u>Overstory Species Composition</u>
According to BLM's Forest Operations Inventory (FOI), Douglas-fir dominated stands presently

occupy 45 % of BLM lands in the analysis area (Table V-1 and Figure V-1). Prior to 1960, this percentage was probably closer to 60 %, as the acres classified as ‘timber sale units’ tended to be concentrated in conifer dominated stands. While FOI information for some stands may be inaccurate, it does offer the best available picture of forest condition. For example, this information commonly identifies stands with a mixed conifer-hardwood stand structure and tanoak; therefore, the data should be used a only as a general point of reference.

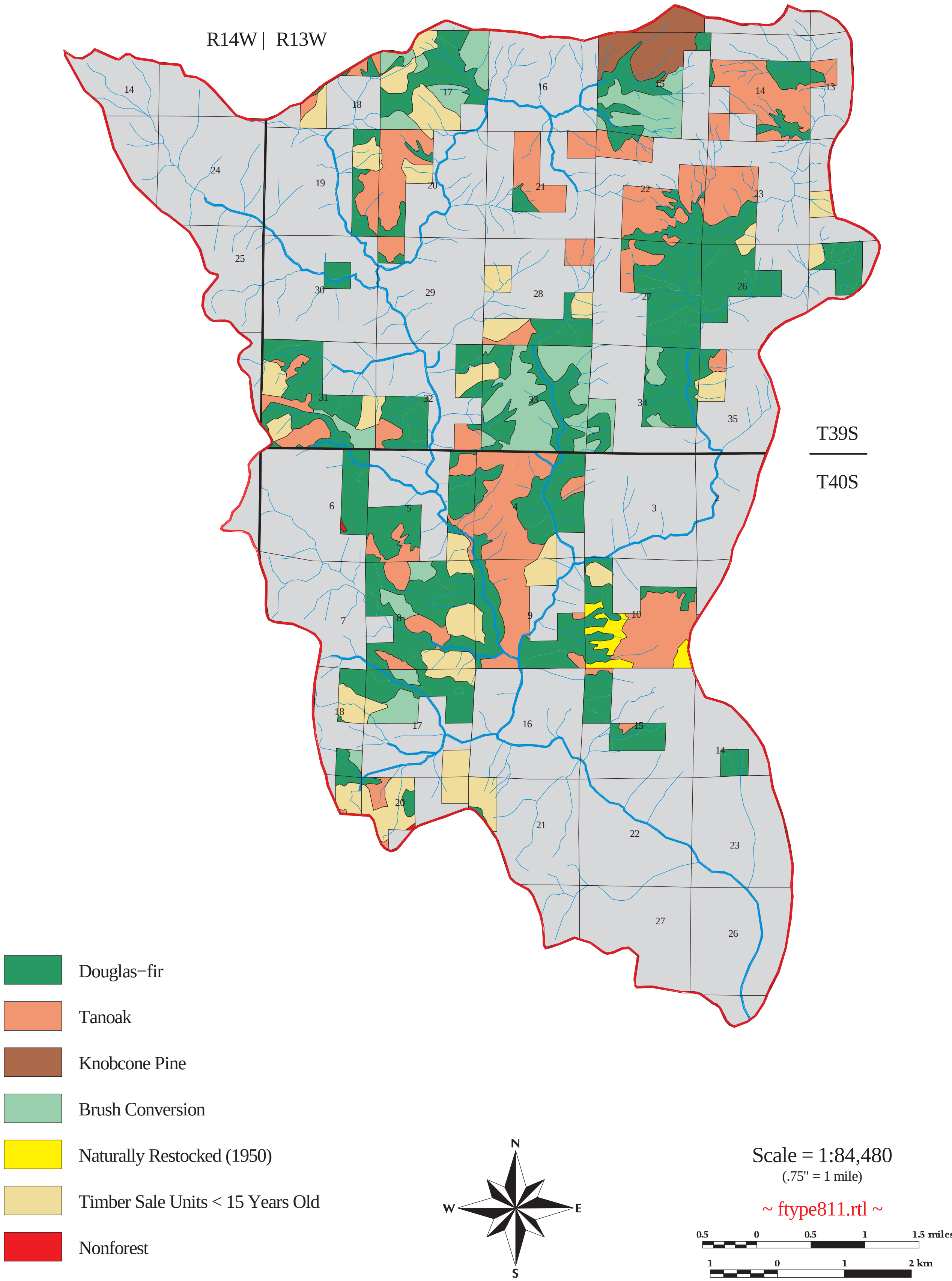
Table V-1 Dominant Cover Type Distribution on BLM Lands

Dominant Cover Species	Acres	% BLM lands
Douglas-fir	4,206	45 %
Tanoak	2,449	26 %
Timber sale units (30 years or less) - planted Douglas-fir	1,261	14 %
‘Brush Conversion’ (generally unmerchantable tanoak or manzanita/young fir/knobcone	997	11%
Knobcone Pine	256	3 %
Non-forest (meadows)	4	<1 %
Total	9,262	100 %

The Douglas-fir stands tend to be located in the south and west portions of the analysis area. Elsewhere it is located lower on the hillslopes adjacent to the stream system. This may be due to several factors, including soil type, climate, and fire. The soil types (117F, 118F, and 165E) may provide better conditions for growth, but preliminary data is inconclusive. The proximity of the analysis area to the coastal fog belt may provide additional moisture that could make a difference over large periods of time. Visual observations reveal that coastal fog occasionally creeps up the lower part of the North Fork Chetco River corridor and along the west boundary of the analysis area. This increase on moisture may influence vegetation. The other factor to be considered is that the northeast portion of the analysis area has had repeated fires, which have removed the Douglas-fir component, except for riparian areas (refer to VI.4-Riparian Habitat). Anecdotal evidence suggests that this area was largely covered with Douglas-fir prior to the fires in the early 1900's.

Early timber sales were concentrated in Douglas-fir dominated stands. Review of information from ten timber sales confirms the presence of a two-species stand composition. The percentage of Douglas-fir stems ranges from 33 to 88%, with the remainder being tanoak. Also, a comparison of tree diameter confirms a two-storied stand structure. The average diameter of Douglas-fir ranges from 28" to 38" d.b.h., while that of tanoak was from 12" to 16" d.b.h.

Figure V−1 Dominant Overstory Timber Type on BLM lands



Review of cruise information from a 1991 sale [1] reveal trace numbers of grand fir, western hemlock, and Port-Orford-cedar trees. This sale was located along the extreme west edge of the analysis area and these species were probably found in an understory position. Review of riparian vegetation surveys conducted along mainstem streams further to the east (refer to Section IV.4-Riparian Habitat) do not reveal the presence of these minor conifer species.

FOI identifies 26% of BLM lands as having a dominate tanoak cover type. Most of these are young tanoak stands that contain a Douglas-fir component. While tanoak has a higher tolerance for dryer, harsher sites than Douglas-fir, these stands are primarily the result of recent human-caused fire and represent an early seral stage in transition. Tanoak is the predominant regenerated tree species due to its ability to regenerate from root sprouts. Nonetheless, Douglas-fir can frequently be found seeding in on areas of exposed soil, such as road cutbanks/fill slopes and landslide areas. Eventually, the Douglas-fir will surpass the tanoak and become a dominant overstory species. However, due to the low initial stocking of mature Douglas-fir in these stands, the Douglas-fir will probably develop a lower percent cover than Douglas-fir stands elsewhere in the analysis area. Some of the area classified as brush conversion include young tanoak and Douglas-fir, or young fir/manzanita/knobcone pine stands. Baring future disturbance, these should develop on a similar trajectory.

Hardwood Stands

Tanoak is rarely found without some conifer component (McDonald and Huber 1995). A majority of the tanoak dominated stands observed in the analysis area are primarily the result of human-caused fire or logging during the 1950's-1970's. The high-grade logging practices during this time removed the residual Douglas-fir component from mixed stands. Consequently, these stands were then converted to those with a high tanoak component (Adams, et al. 1992). It is though that naturally occurring tanoak hardwood stands would comprise only a small component of the landscape. Pure or nearly pure tanoak stands are initially created by high intensity fires (Agee 1993) and are representative of an early successional stage (Neimiec et at. 1995).

Some pure or nearly pure stands of red alder are located in the riparian areas. These stands have developed in response to disturbance activities, logging and road construction (refer to Section IV.1-Aquatic Habitat).

Knobcone Pine

Knobcone pine (*Pinus attenuata*) is generally found in pure ,even-aged stands, the largest of which is concentrated in the Bosley Butte portion of the analysis area, and occupy at least 256 acres (3 %) of BLM lands (Figure V-1). This acreage does not reflect the smaller pockets distributed throughout the rest of the area and could be as much as 50% higher. In addition, no estimate of the acreage on private lands has been determined, but is expected to be small based on visual estimates. Manzanita (*Arctostaphylos* spp.) forms a dense shrub layer in association with the pine and

[1] Timber sale cruise data prior to this time often did not contain trees less than 12" d.b.h. or if the total volume of the minor tree species was less than 10 MBF for the sale. Therefore, minor conifer tree species might have been present, but not recorded.

Douglas-fir dominated stands are often adjacent.

Stands of knobcone pine appear to be strongly associated with the Jurassic w/volcanics geologic formation (Jv) (Figure III-1). This underlying geology is composed of pillow basalt and breccia of the Dothan formation and may be moisture limited. Also, these areas are more resistant to weathering and are generally located on the higher elevations or high points in respect to the neighboring terrain. Wildfires tend to burn hotter in these higher areas which results in an environment more suited to the establishment of knobcone pine. Knobcone pine has serotinous cones which release their seeds following high intensity fires (Harlow and Harrar 1969). These repeated high intensity fires remove other conifer or hardwood tree species and prevent their reestablishment, consequently, species such as knobcone or manzanita occupy the site (Agee 1993).

Bryophytes, Lichens, and Fungi

Vegetative diversity not only includes the number of species (richness), but also the genetic diversity within species, community, and ecological process diversity. This also includes vascular plants, non-vascular plants (bryophytes - mosses, liverworts and hornworts), lichens, and fungi. No data is available to make an accurate estimate of the diversity and biomass of bryophytes, lichens and fungi within the analysis area. (refer to Section VI-Riparian Reserve Evaluation, for a partial list of species which may occur in the analysis area).

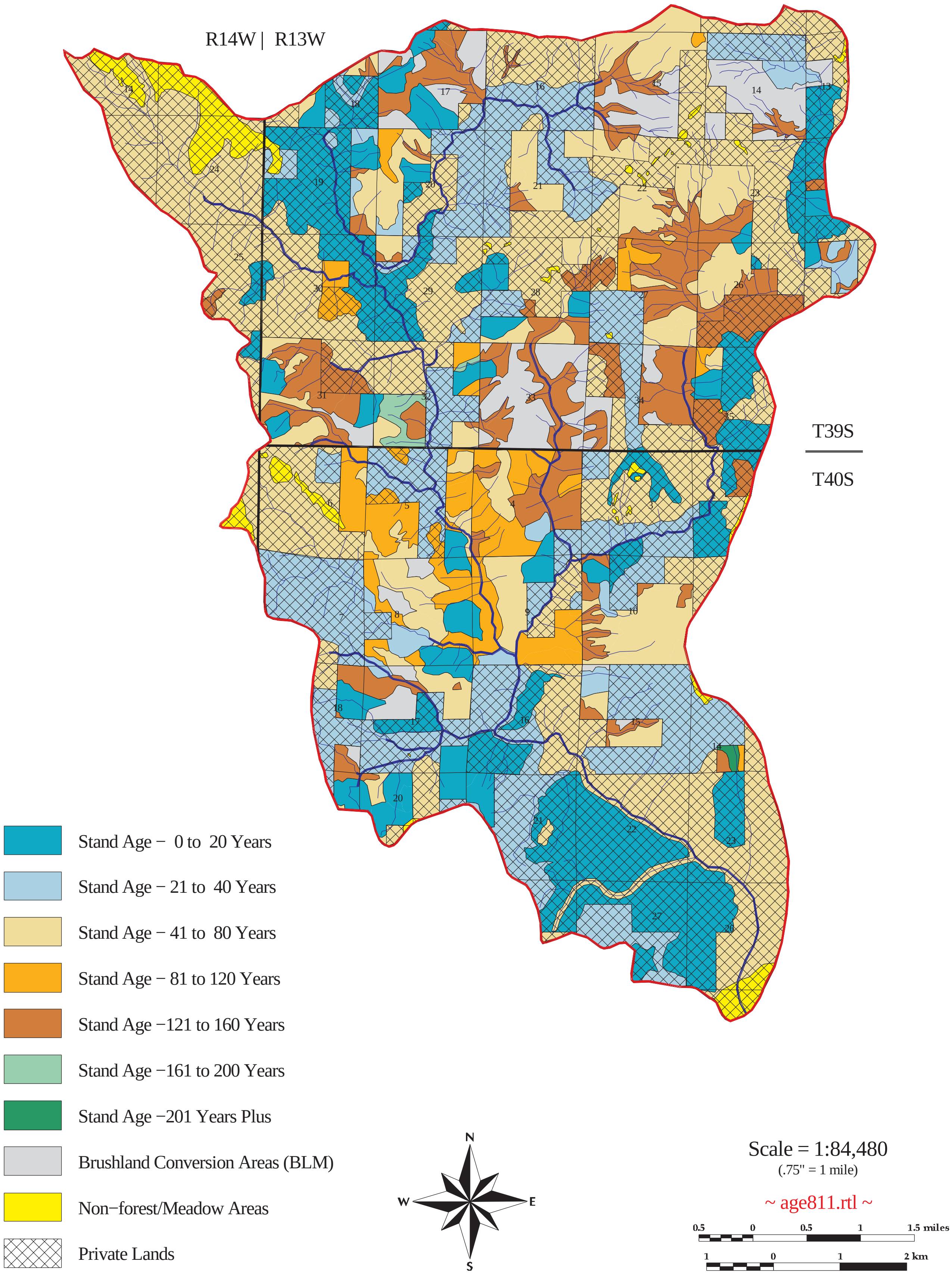
Bryophytes play important roles in the maintenance of ecosystem stability including regulating water relations and nutrient cycling. They also provide food and habitat for many invertebrates and vertebrates, maintenance of forest stream ecosystems, help increase soil stability, and providing a seed bed for many plant species.

Fungi profoundly affect nearly all ecological processes and events, either directly or indirectly, which occur in coniferous forest ecosystems (Trappe and Luoma 1992). Ecological roles that fungi have include, mycorrhizal associations with nearly all woody vegetation which aids growth and in some cases protection from diseases, nutrient cycling (saprophytic fungi), soil aggregation, food webs, and diseases, such as *Phellinus*, which helps create forest gaps thus increasing forest complexity.

What is the current age distribution forested stands?

The age distribution in the analysis area can best be characterized by young stands (<= 40 years of age) covering 38 % and 'pole-timber' stands (41-80 years) covering 43 % (Table V-2). Old growth forests (> 200 years of age) occur on only 1%. The relatively high acreage of stands in the 41- 80 year age-class reflects the large percentage of the area that has burned this century, as well as high levels of harvest on private land in the 1950's. Age distribution on BLM lands is roughly similar with the largest age groupings being the pole timber stands (43 %) followed by mature timber (25 %). For use in habitat evaluation, reclassification of this age class data by seral class may be of better use (refer to Section V.2-Terrestrial Habitat). The location of different age classes is shown in Figure V-2.

Figure V−2 Timber Age Class Distribution



Cursory aerial photo interpretation suggests that 15 % of private land has not yet been harvested, however, of this only 3 % could be classified as late-successional, conifer forests. Therefore, old growth forest habitat is virtually absent from private land. Private land is primarily managed for timber production or livestock grazing and will likely never provide significant amounts of late-successional or old growth forests.

Table V- 2 Acreages of Various Age Classes

	BLM Ownership (9,262 ac)		Private Ownership (16,300 ac)		TOTAL (25,562 ac)
Forest Age Class	Acres	% of BLM	Acres	% of PVT	% of Total
meadows	4	< 1 %	567	4 %	2 %
0 - 20	1277	14 %	3349	21 %	18%
21 - 40	399	4 %	4641	29 %	20 %
41 - 80	4002	43 %	7076	43 %	43 %
81 - 120	1180	13 %	114	< 1 %	5 %
121 - 160	2297	25 %	523	3 %	11 %
161 - 200	85	< 1 %	-	-	< 1 %
200 +	18	< 1 %	-	-	< 1 %
Totals	9,262	36 %	16,300	64 %	

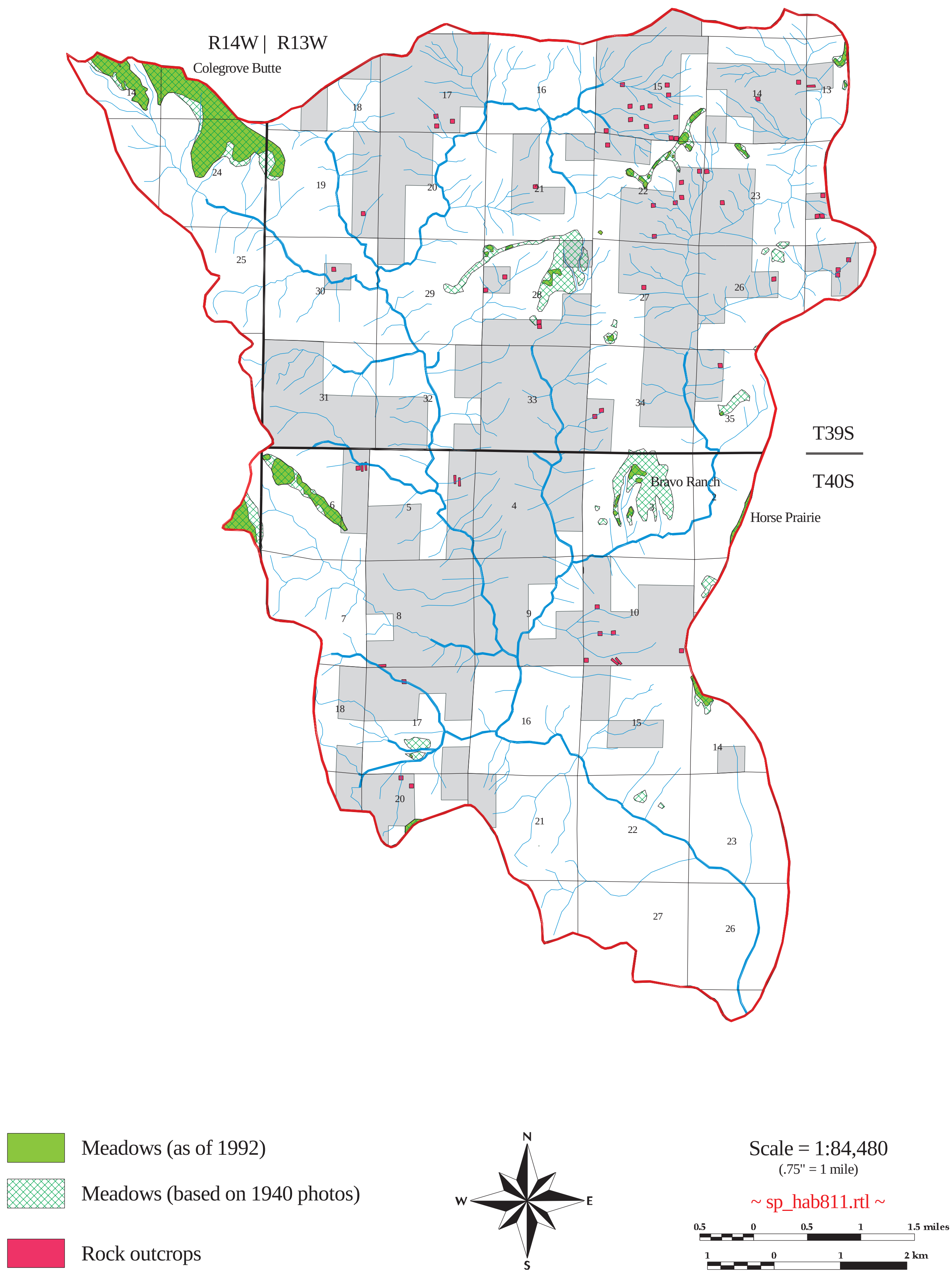
Stratifying the stands by age class or seral stage is especially difficult in this area. FOI is often inaccurate and one age class may often encompass stands of varying ages and densities. At least half of the stands in the 41 to 80 year age class contain tanoak. These stands contain trees of multiple ages and small pockets of older conifer which have not been represented. This data for older stands (>40 years or so), FOI offers the best available picture of forest condition. FOI information for young (managed) stands, particularly those < 30 years old, is far more accurate. Data on private lands is interpreted from aerial photography and is less accurate.

What are the special or unique plant communities and the processes affect them?

Meadow Areas

Visual estimates from 1940 aerial photos show approximately 1000 acres of meadow type habitat (Figure V-3). These ‘grass balds’ were commonly located on high ridgetops with generally a southern exposure and are strongly associated with soil type 255E. A weaker association exists for soil types 066E, 152E, and 238D. The origin of some of these areas may owe their existence to fire (Franklin and Dyrness 1973). Human influence probably was the factor in establishing the larger meadows located along the boundary of the analysis area.

Figure V-3 Special Habitat Areas



Areas, such as Horse Prairie and Bravo Ranch, were maintained through grazing practices. The remains of old fencing can be located along the edges of several other meadows. As to the smaller meadows in the center portion of the analysis area, these may have been maintained in an open condition by wildfire or by Native Americans. Agee (1993) suggests that Native Americans may have frequently burned areas along ridgetops to maintain open travel corridors and promote the growth of hazel and beargrass.

Currently, there are approximately 500 acres (2% of the analysis area) of open meadow habitat left, most of which are the larger areas still being grazed by livestock. The smaller ridgetop grass bald areas are have been reduced in size by encroachment of Douglas-fir. This is due to the current policy of wildfire suppression or intentionally by planting of tree seedlings.

What effect does fire and other disturbances have on the vegetation communities found within the analysis area?

It is unlikely that any plant species have been extirpated from the analysis. Historically, plant diversity most likely remained stable over time with the species composition fluctuating depending on the age of the forest stand. Following disturbance events, many early successional species most likely invade these disturbed areas. Once canopy closure was reached, plant diversity temporarily decreases, until the stand reach an age where canopy gaps began to develop and diversity again increases.

<u>Fire</u>
Large fires, whether natural or human caused, do not typically consume all vegetation within its boundaries. In addition, fires of differing intensities result in a complex landscape with gradual transitions between stands and many complex stands with varying species compositions and differing amounts of residual stand components. This is particularly evident within the analysis area.

The 1939 fire (Figure III-25) resulted in a predominately even-aged cover of tanoak with large residual Douglas-fir adjacent to streams or on more protected northerly aspects (refer to Section IV.4-Riparian Habitat).

The area around Palmer Butte (Sec. 10, T. 40., R. 13 W.) has been burned over several times in a relatively short time. Currently, this area burned has a dense cover of manzanita, but young Douglas-fir are reestablishing themselves and will eventually dominate the site in the absence of additional fire. Stands burned in 1945 in Sec. 33, T. 39., R. 13 W. that had areas covered predominately by tanoak in the 1950 aerial photos, display a cover of mixed hardwood/conifer on the 1992 photos.

Fire intensity may play a more important role in controlling the which plant species will dominate the site. A low intensity fire will remove the understory hardwoods such as tanoak and Pacific madrone, while the dominate more fire-resistant Douglas-fir survive. These hardwoods species have the ability to sprout from their roots and will re-occupy understory again. In stands with older fire-resistant bark, moderate intensity fires burn back the hardwoods, while preparing sed bed for the remaining Douglas-fir to reseed. Douglas-fir, which can seed prolifically on bare soil in this area, will eventually grow through the hardwood canopy if it becomes established. Thus, fires of this intensity may be an important factor in converting tanoak stands to those dominated by Douglas-fir. With the policy of wildfire suppression, this process will not be allowed to occur and hardwood stands will not convert to conifer. A high intensity burn or one in a young Douglas-fir stand will kill this Douglas-fir seed source and pure hardwoods or species such as knobcone pine and manzanita will dominate the new stand (Agee 1993 and USFS Forest Service 1996a). Repeated fires will similarly result in stands of these species.

<u>Wind</u>
Like landslides, small isolated areas of blowdown of hardwood trees in the mixed conifer/hardwood stands may aid in the establishment of Douglas-fir seedlings. These small blowdown areas result in exposing bare soil when the root mass is lifted out of the ground. The resulting bare soil serves as a seedbed for the Douglas-fir.

<u>Human Disturbance</u>
Current disturbance patterns are typically human caused (extraction of forest products) and tend to simplify forest conditions (such as creating a single aged stands, removing large down wood, and intense site preparation) which create definite edges. These current disturbances also occur on a more regular basis, and occur are repeated over shorter time frames. Historic disturbances (fire, wind, pests, and landslides) on the other hand, were generally low in intensity (the exception being stand replacing events) thus creating more of a mosaic across the landscape which in some cases maintained or enhanced forest structure through the creation of more snags, increasing the amount of large down wood, retaining of live trees (both in small clumps and scattered), and creating forest gaps. Because of these factors, the diversity and biomass of these species was probably higher than what currently exists in the .

Across the landscape (including private land), early seral habitats are more common than late-seral habitats. On BLM lands, the historical large blocks of similar aged stands have been replaced with a fragmented pattern characterized by hard edges (distinct contrast between adjacent stands) and small patch size (on the order of 40 acres). During the 1970's and 1980's the Bureau restricted clearcut size to approximately 40 acres, and attempted to distribute their locations so that adjacent areas were at least 10 years old. The belief at that time was that this practice would benefit wildlife due to the resultant edge-effect (Thomas 1979). On private lands, larger areas have been harvested, and clearcuts were often adjacent to the previous years harvest, resulting in larger tracts of land uniform in age. Also, harvest during the 1950s and 1960s often removed the large conifer overstory (high grading) leaving the hardwood understory to dominate the stand after harvest.

Are there any special status or survey and manage plant species in the analysis area?

Special status plants currently known to exist include golden fleece (*Ericameria arborescens*) and Coast fawn lily (*Erythronium revolutum*).

Golden fleece is a species which reaches its northern limit in extreme southwest Oregon in Curry County but is widespread in California occurring to Ventura County. It is only known from three locations in Oregon totaling 21 plants. The one known site occurs along the Bosley Butte road, near the junction with the road that leads to top of Bosley Butte. In Oregon it occurs on hot dry slopes with a southeast, south or southwest aspect (Zika 1993). This is usually the case for a southern species reaching its northern limit. This species appears to occur in early successional habitats and flowers more readily following a fire. Golden fleece appears to be associated with knobcone pine and chaparral habitats (Zika 1993). Locations of Coast fawn lily have been documented but not located in recent years. Coast fawn lily is at the southern limit of its range and occurs moist forest conditions and riparian areas.

No formal inventories have been conducted within the analysis area for bryophytes, lichens and fungi (including Survey and Manage and Protection Buffer species) and it is likely that many of these species occur.

What effect does the current forest condition have on hydrologic processes?

Table V-2 shows that 40% of all forest ownerships in the analysis area have an age of 40 years or less. Generally it has been found that increased annual water yields occur in young forest stands and full hydrologic recovery in regenerating forests is seldom achieved until the trees are large enough to be transpiring water effectively. Future timber harvest is anticipated to be on a 80 year rotation on BLM lands and shorter on private lands. This could result in approximately half of the analysis area being in less than 40 years of age. This may result in a downward trend in hydrologic recovery. However, there is insufficient modeling or research results to determine the effects of less than full hydrologic recovery on peak flow increases in precipitation dominated Coast Range areas.

Risk of peak flow increase (10-20%) is principally along tributary streams above 2000 feet. In this area, shallow snowpacks come and go several times each winter. Under the right climate conditions (intense rain with snow as stored water on the ground) increased runoff can result from many forest openings, as more snow is present and melts faster. Approximately 5% of the analysis area, centered around Upper Bravo and Bosley Creeks, is susceptible to this peak flow increase from too much removal of forest vegetation. If too much forest from the higher elevations is removed, or if roads and road drainage are not properly maintained, or if more than about 8% of the land area is compacted in tributary drainages, slight-moderate risk of increased peak flows will continue.

What effect does the current forest condition have on terrestrial habitats?

The combination of fire and salvage logging of snags and down logs has greatly reduced the availability of these habitat features for wildlife (see Sections V.2 & V.3).

It is not fully understood what impact the introduction of non-native grasses and forbs has had. Some early seral species have benefitted from their presence and surface erosion has been reduced, but the long term effects on the ecosystem are unknown.

What effect does the current forest cover have on soil and erosion processes?

The cover provided by the current forest canopy is sufficient to protect the soil and reduce its loss by erosional processes. Tanoak affords protection to the ground that is not available from other hardwood species. Being an evergreen tree species, it retains a canopy throughout the winter months, protecting the soil from the direct impacts of rainfall. Following harvest, it may take approximately 6 to 8 years for the vegetation to produce sufficient cover to reduce surface erosion. The presence of tanoak can decrease this time frame to approximately 3 years by it ability to sprout vigorously from its roots.

Even with the trend toward removing the vegetation at regular intervals (80 year harvest cycle), it appears that surface erosion from harvesting should be sufficiently reduced, especially from BLM lands due to the filtering effects of the Riparian Reserve network. Harvest areas rapidly revegetate with sufficient ground cover to limit surface erosion. Riparian Reserve areas adjacent to streams will act to filter out sediment.

What is the trend for the vegetative communities within the analysis area?

Vegetative Composition

Plant diversity has probably remained relatively the same over time with minor fluctuations based on the amount of and time since the last disturbance event (natural- or human-caused). There appears to be no vascular plant species restricted entirely to late-successional forest conditions although some species reach their highest biomass in these communities, such as some mycotrophic plant species (Franklin et al. 1981). While some studies (Habeck 1968, Schoonmaker and McKee 1988) indicate that early successional stages have a higher plant species diversity, data from Spies (1991) indicates that species diversity may be higher in older forests (this is especially true when bryophytes, lichens and fungi are included).

The predominant Douglas-fir/hardwood plant community will undoubtably remain a viable component of the analysis area. However, the trend is different for special communities, such as meadows. With the intentional planting and rapid encroachment of Douglas-fir into these areas, the meadow community will probably disappear within the next 20 years. With the policy of wildfire suppression, it is probable that the adjacent Douglas-fir will eventually encroach and also replace most of the knobcone pine plant community. However, given the slow growth rates on these poor sites, this process will take many decades for the knobcone community to become absent.

The simplification of forest ecosystems through past intensive forest practices most likely has lead to a reduction in bryophyte, lichen and fungi diversity and biomass across the analysis area. This reduction also results in losing the important ecological roles that these species have in these ecosystems. Recently there have been some efforts by Tappenier and others to look at how some forest activities (thinning, density management) may increase the diversity of the these species in younger aged forests. Again, the direct cause of increased diversity and biomass of these species is not stand age, but the characters associated with older forests. If some of these habitat characteristics in younger forests can be created, it may be possible to maintain these species across the landscape. The creation of forest gaps, retention of green trees, snags, and large woody debris retention are important habitat components for these species. Work by Neitlich (1995) has shown some promising results that the diversity of these species can be maintained for younger age classes.

Age Distribution

Private lands and those BLM managed lands designated as GFMA will be maintained in an early to mid-seral stage (40-80 yrs. old) depending upon ownership and timber market conditions. If private lands are managed on 60 year rotations, age classes may be fairly evenly split between 0-20, 21-40, and 41-60 year age classes. Stands in Reserve land use allocations will eventually develop into late-successional forests, which will eventually occupy at least 55% of BLM lands or 20% of the overall area.

While the age of the forest is important in determining the biomass and diversity of bryophytes, lichens and fungi, it probably is a result of many environmental and structural factors associated with older, mature forests. Older forests typically have greater canopy structure which provides more available and stable substrates, aids in air circulation, therefore ameliorating the relative humidity (lichens are unable to tolerate continuous high relative humidity (Goward 1992)), have greater amounts of large woody debris in all decay classes, and a higher diversity of tree species (Franklin et al. 1981, Spies and Franklin 1991). Therefore, it appears to be these habitat features associated with older forests and not stand age that influence the bryophyte and lichen diversity and biomass. It is quite possible for a younger forest with these habitat feature to have a greater diversity and biomass of these species than an older aged forest.

What is the management objective for vegetation in the analysis area? At what level and where can hardwood/brushfield conversions be performed?

The management objective for vegetation is to maintain the plant diversity (including genetic, species, and community diversity) found in the analysis area. The different plant communities contain a wide variety of species. The extirpation of native plant species should be viewed as a irreversible and irretrievable loss of a resource. Future planning of forest activities should consider the potential impacts to these species and way to create habitat features for the benefit of these species.

With BLM's current management direction, it is not likely that historic patterns of vegetation can be restored in the analysis area, primarily due to the policy of fire suppression. GFMA lands will be managed for timber production and early seral species where not in conflict with management of Key Watersheds. Forest practices under the Standards and Guides incorporates some of the key structural components produced by natural disturbance processes (ie., snags & down logs, species mixes, and landscape patterns). These objectives may also provide some benefit for mid and late-seral species. Silvicultural practices, such as precommercial thinning, commercial thinning, release treatments, fertilization, hardwood and brushfield conversions, are valuable tools to promote stand vigor, species mix and fully implement ecosystem management.

A majority of the tanoak dominated stands present in the analysis area are the result of human influence, fire or harvest. This may be a largest factor in that, as a whole, the acreage of hardwood stands throughout the Chetco basin is at the high point in its range of variability (USFS Forest Service 1996a). Being that, it would appear that some level of conversion of tanoak dominated stands to conifer or conifer-mix may be necessary. With 26% of the area in tanoak or mixed tanoak/Douglas-fir stands, ample opportunities are present for conversion opportunities.

V.2 TERRESTRIAL HABITAT

What are the key habitats or habitat components in the analysis area?

Key habitats and habitat components were identified using the following criteria:

- Habitats or components that are relatively scarce in the landscape.
- Habitats or components that support wildlife species of special management concern or that support an unusually high number of species.
- Habitats or components that might be affected by potential management actions .

Key habitats include:

- Vegetation Complexity and Species Composition - Fire has heavily influenced the species composition, distribution, and complexity of vegetation and structure available at a particular location and across the landscape (see Section III.7-Disturbance). Fire suppression, timber harvest, and planting (or lack of planting) during the last 50 years has begun to change the composition, structure, and distribution of vegetation. Future management actions such as timber harvest and silvicultural activities will continue to influence vegetation complexity and species composition. The changing vegetation and distribution of the vegetation heavily influence wildlife which depend on the vegetation for habitat.

- Snags and Down Logs - Snags and down logs are critical habitat components because they support such a large number and variety of species including invertebrates, amphibians, woodpeckers, and cavity-nesting birds and mammals. They also fulfill other important ecological functions such as nutrient cycling and moisture storage.

- Rocky Habitats - Compared to Coast Range habitats, the Klamath Province provides a larger number and variety of rocky habitats. These rocky habitats include talus, rocky outcrops, and larger cliffs; the analysis area contains many rocky habitats distributed across it. These rocky habitats provide unique microclimates which in turn, support many fairly specialized wildlife and plant species including several species of special management concern.

What was the historical condition, pattern, and distribution of key habitats in the analysis area (Reference Conditions)?

<u>Vegetation Complexity and Species Composition</u>
Historic aerial photos (1940) show a landscape with large and small Douglas-fir trees, often along drainages, and especially prevalent in the southern and southwestern portion of the analysis area which was not disturbed by the 1939 fire. Tanoak was also very common, especially on side slopes and ridges and in the middle portion of the analysis area. Tanoak stands often contained fingers or patches of Douglas-fir. Knobcone pine occupied areas of more intense fire or poorer soils on some ridge tops and in the Bosley Butte area. Meadows occurred on a few ridge tops. Other than the large area of knobcone pine around Bosley Butte, pure stands were uncommon as areas usually contained complex mosaics of Douglas-fir, tanoak and other hardwoods, with occasional patches of

knobcone pine or meadow. Fires left occasional large, irregularly-shaped brush fields and early successional stands (refer to Sections V.1-Vegetation and III.7-Disturbance for more discussion of fire effects). Snags (and eventual down logs) were often patchily distributed across the landscape and through time, as occasional fires created pulses of snag and down log availability (see Snag and Down Log discussion below).

The 1940 photos reveal many meadows on ridge tops in the headwaters of Jim Ray Creek, on Colegrove Butte, and on the ridge separating Ransom and Bravo Creeks. Some of these could have been created and maintained by actions of early European settlers. Settlers set frequent fires in southwest Oregon in the late 1800's and intensive sheep and cattle grazing occurred around the turn of the century (Atzet and Wheeler 1982).

Snags and Down Logs - Historic aerial photos reveal a patchy distribution of snags (and eventual down logs) across the analysis area. Occasional fires created pulses of snags which would then progress through decay classes. The Siskiyou Natl. Forest measured down log levels in vegetation plots and found 2800 ft^3/acre (three standard deviations encompassed 550-5100 $ft^{3/}$/acre) for the tanoak plant association series. This figure needs to be verified and checked for applicability to the analysis area. Table V-3 shows average availability of snags and down logs in unmanaged stands in the Klamath Province from Bingham and Sawyer (1991). Their study area did not include any coastal sites in southwest Oregon, so their findings may not be directly applicable to the analysis area.

Rocky Habitats - The analysis area contains many rocky habitats throughout it. Rocky outcrops and associated talus are often intrusions of different geologic parent material (Ti or Jv) found in such places as Colegrove, Bosley, Palmer, and Cassidy Buttes. Rocky outcrops are especially prevalent in Bravo Creek and south of Bosley Butte. Talus habitats are also common except in the Otter Point formation in the northwest corner of the analysis area.

Rocky outcrops and cliffs provide unique nesting habitat for raptors, swallows, and other birds. They also absorb heat during the day and release it through the night providing a unique microclimate with tempered daily temperature fluctuations. The microhabitats provided by rocky outcrops and talus are heavily influenced by surrounding vegetation. Some of these rocky habitats burned intensely or contained relatively unproductive soils which supported short, dense stands of knobcone pine. Others were located low on slopes and were perpetually shaded by hillsides and large Douglas-fir trees which survived the occasional fires. Variety of microclimates across the landscape and through time characterizes rocky habitats in the analysis area.

Table V-3 Average numbers of snags/acre and volume of down logs/acre (all decay classes)[+- 2 standard errors] in naturally regenerating stands in the Klamath Province (from Bingham and Sawyer, 1991).

	Young (40-100 yrs old)	Mature (101-200 yrs old)	Old Growth (>200 yrs old)
# conifer snags/acre >= 16 in. dia. and 13 ft tall[1]	0.6 [0.2 - 1.1]	0.6 [0.1 - 1.0]	2.0 [1.2 - 2.8]
# hardwood snags/acre >= 8 in. dia. and 7 ft tall	2.7 [0.8 - 4.6]	8.1 [4.0 - 12.2]	2.1 [1.1 - 3.0]
# down logs/acre > 17 in. dia. and >=13 ft. long	11.8 [5.2 - 18.3]	2.9 [1.0 - 4.9]	10.0 [7.6 - 12.4]
biomass (ton/acre) of down logs > 17 in. dia. and >=13 ft. long	7.2 [2.7 - 11.8]	1.6 [0.6 - 2.5]	8.1 [4.9 - 11.3]
volume of down logs > 17 in. dia. and >=13 ft. long (ft^3/ac) [2]	808 [309 - 1316]	175 [65 - 284]	908 [549 - 1267]

[1] Minimum retention levels for snags from the RMP equate to approximately 40% (theoretically) of levels found in natural stands.
[2] The minimum down log retention levels for hard logs (decay class 1 and 2) from the RMP equate to 167 ft^3/ac (approximately 18-95% of what is found in natural stands). Divide ft^3/ac by 1.39626 to get the number of feet of 16 inch diameter log necessary to equal the given volume. Biomass figures from Bingham and Sawyer (1991) were converted to volumes using average density figures for Douglas-fir logs, decay class 1-4, reported in Spies et. al. (1988).

What is the current condition, pattern, and distribution of key habitats in the analysis area ?

Vegetation Complexity and Species Composition - On the Coos Bay District, the systematic forest inventories needed to accurately evaluate the abundance and distribution of key vegetative and structural forest components have not been conducted. As a result, only a general analysis of forest complexity and its effects on wildlife can be presented at this time. These inventories need to be conducted to facilitate more detailed future analysis.

The majority of the area (83%) supports early seral habitat, the vast majority of which is the result of timber harvest (clear cuts or high grading) (Table V-4 and Figure V-4). Compared to other subwatersheds in the Resource Area, the North Fork Chetco analysis area contains larger blocks of relatively unmanaged stands. Conventional methods of logging, site preparation, regeneration, and stand maintenance do not mimic the natural disturbance processes thought to have maintained this landscape prior to Euro-American settlement; these managed stands generally lack the snag, down log, and remnant trees that often remained after fires. In the mid 1900s, large Douglas-fir trees were sometimes high-graded out of stands leaving hardwood dominated stands with few young conifers to replenish those that were taken out. Harvest also altered the pattern of vegetation, replacing the irregular, and often finger-like, mosaic with a more regular pattern. A landscape with lots of low contrast edges has been replaced with possibly less edge, but generally high contrast edges. The ultimate result is a vegetatively and structurally simplified landscape.

Figure V-4 North Fork Chetco Seral Stages

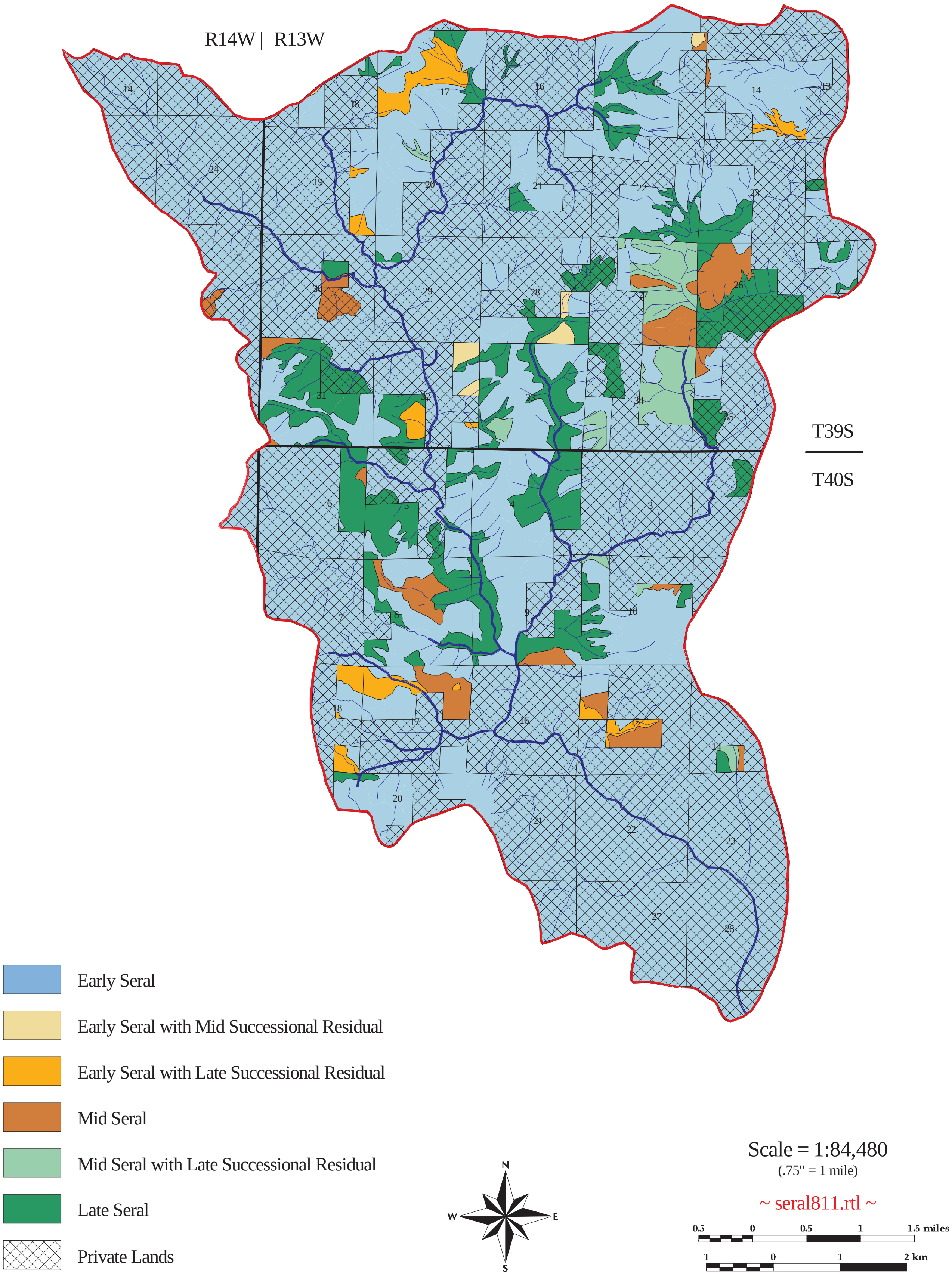


Table V-4 Acreages of Various Seral Stages

	BLM Ownership (9,262 ac)		Private Ownership (16,300 ac)		TOTAL (25,252 ac)
Seral Stage*	Acres	% of BLM	Acres	% of PVT	% of Total
Early Seral	5501	59%	15663	96%	83%
Early + Residual Late-seral	401	4%	0	0%	2%
Early + Residual Mid-seral	90	1%	0	0%	0%
Mid Seral	642	7%	114	1%	3%
Mid + Residual Late-seral	508	5%	0	0%	2%
Late	2120	23%	523	3%	10%
Totals	9262		16300		

* Seral stages classifications were based on tree size, stocking density, number of canopy layers, and age (private land only).

Fifteen percent of the analysis area supports a combination of mid and late-successional forest patches, found almost exclusively on BLM administered lands (Table V-4 and Figure V-4). Many of these late-successional forests are along streams. From a habitat perspective, these stands are vegetatively and structurally complex, containing canopies of much greater volume and habitat complexity than the single storied, uniform canopies typical of many plantations. These complex stands support a greater abundance and diversity of birds, bats, rodents, invertebrates and other species which forage, roost, or reproduce in the canopies; however, the small size and relative scarcity of these patches may limit their value for some species.

In the analysis area (as with other areas in the heart of the Klamath Province), drainage density (4.3 mi/mi.^{2}) is lower than many Coast Range watersheds and the contrast between vegetation along streams and the uplands is greater. Vegetation along streams (the remnant old-growth patches which regularly escaped stand-replacement fires because of their location) offers more structural diversity than vegetation upslope. These linear patches of late-successional forest likely offer more vegetation layers; as well as more cavities, broken tree tops, deformed limbs, etc. than upslope vegetation. The diversity of tree species (and presumably other species as well), particularly hardwoods, is also greater along streams.

<u>Snags and Down Logs</u> - Little information exists on current availability of snag and down log habitat in the analysis area. Stream habitat inventories along Ransom, NF Chetco, and Bravo creeks found 0.8 snags/acre within 100 feet of the streams (Table V-5). Managed stands probably have very little snag and down log habitat on them because management practices generally did not require or encourage the retention of these structures. Limited pre- and post-harvest fuels inventories showed few, if any, down logs. Post harvest fuel inventories support the assumption that harvest units retain few down log and snag structures. If managed stands contain few if any down log and snag structures, that means that 61% of the analysis area may be deficient in these

important habitat structures.

Table V-5 Numbers of snags/acre (all decay classes) within 100 feet of streams in the North Fork Chetco subwatershed (from 1995 Riparian Vegetation Inventories).

	Ransom Cr (mostly unmanaged)	NF Chetco R. (mostly heavily managed [pvt.])	Jim Ray Cr (all BLM, some mgmt)	Totals
# conifer snags/acre >= 16 in. dia.[1]	0.8	0.4	1.0	0.6
# conifer snags/acre >= 11 in. dia	0.9	0.5	1.1	0.7
# hardwood snags/acre >= 8 in. dia.	0.2	0.1	0.1	0.1

[1] Minimum retention levels for snags from the RMP equate to approximately 1.5 hard snags/acre.

Rocky Habitats - The availability of rocky habitats remains unchanged from historic conditions. Based on some limited field surveys, many of these formations contain at least one or two deep cracks that could be used by bats. Many also contain protected ledges or cavities that could be used by other wildlife for resting. Talus areas provide habitat for invertebrates, amphibians, sharp-tailed snakes, among others. Figure V-3 shows locations of some rocky outcrop habitats.

How have management activities affected the condition, pattern, and distribution of key habitats in the analysis area?

Vegetation Complexity and Species Composition - Approximately 61% of the area has been harvested. Harvest has changed structurally diverse stands into stands with a more uniform structure and species composition (mostly Douglas-fir). Stands which were high-graded similarly have had their structural complexity reduced and their species composition changed to reflect a higher hardwood species composition. Both types of harvested stands generally contain less vertical structure (one or two canopy layers instead of 2-4). The hardwood stands present in the analysis area are primarily the result of human caused fires since the mid 1800's. The ratio of conifer dominated stands to hardwood dominated stands prior to Euro-American influence is unknown. The effects to wildlife of simplifying the structure and composition of stands are unclear. Species such as spotted owls which require diverse forest structures like multiple canopy layers, diverse roosting options, deformed or dead trees, have likely declined in abundance as their habitat has been removed and degraded (simplified).

The pattern of vegetation has also been changed by management. Patch size has probably decreased. Mid and late-seral conifer stands were most common on north and east aspects and early seral stands and hardwood more common on south and west aspects. Forest management disrupted this pattern by fragmenting it with harvest units. The continuity of late-seral conifer stands along streams was also disrupted by creating hardwood-dominated stands in some areas (by high-grading conifers) and conifer-dominated stands in other areas (by planting and intensive maintenance of conifers). Where low and moderate-contrast edges were prevalent historically, high contrast edges now dominate. Some stands that once grew conifers, now support only hardwoods because conifers were high-graded out. High-grading usually occurred along streams and on private lands. Many current hardwood stands are the result of human-caused fires; although fires would likely have naturally burned some of these same areas on their own.

Fires have perpetuated early-seral forest, meadow, and knobcone pine communities. These habitats, with the exception of meadows, were always common in the landscape and are still common in the analysis area. The "naturalness" of meadows is subject to question as they may be the result of consistent livestock grazing. These habitats certainly support unique plant and animal communities. The meadows are also undoubtedly shrinking in the analysis area as conifers are planted or otherwise encroach upon them.

Snags and Down Logs

Snags- The Snag Recruitment Simulator Model (Marcot 1991) suggests that approximately 1.5 hard snags/acre, >= 11 inches dbh, distributed across the landscape are necessary to provide sufficient hard snags in the present and soft snags in the future to meet the RMP minimum of 40% cavity nesting bird potential. Approximately 4 hard snags/acre >= 11 inch dbh are necessary to provide 100% cavity nesting bird potential. See Appendix D, Table D-1 and D-2 for snag numbers and sizes necessary to meet various cavity nesting bird potential. The model further suggests critical snag shortages in the near future, unless additional snags are created through management. Even with aggressive snag creation efforts, sort-term shortages of soft snag habitat are probably inevitable because it takes 19-50 years for a hard snag to become a soft snag, decay class 3+ (Cline et. al. 1980). (Refer to Appendix D for further information on snag model runs).

The District RMP directs that snags be retained sufficient to support cavity nesting species at a minimum 40% of potential population levels throughout the GFMA. It will take at least 60 years (one harvest rotation) to eventually meet the 40% population level on GFMA lands, if snag creation efforts are limited to harvest units. It is possible to hasten the attainment of the 40% population potential goal on GFMA lands by either managing for >40% population potential in harvest units or creating snags on other GFMA lands before they are subject to regeneration harvest. Even if these levels are eventually achieved throughout the GFMA, actual cavity nester population levels on the landscape will likely be much lower, due to the lack of snags on intermingled private lands.

Snag abundance is also probably critically low on Reserve lands and will continue without aggressive snag creation efforts. The current lack of hard snags (and therefore, future soft snags) creates a situation where it will be impossible to meet snag density goals for both hard and soft snags for at least 19-50 years.

Location of snags is also important. Preliminary radio telemetry data on bats suggests at least some species may preferentially roost in ridge top snags. Harvest practices in the past tended to leave most wildlife trees on the edges of harvest units, but doing so precludes options for maintaining snags in a variety of topographic positions. Snags representing a variety of decay classes, topographic positions, seral stages, and distributions (i.e. large and small clumps and singly) need to be provided through time.

Backup data for Table V-3 suggests that hardwood snags (and presumable down logs as well) are common in Klamath Province forests of all ages. This data indicates that the density of hardwood snags was 4-5 times that of conifer snags in young stands. Current NFP/RMP management for these structures relies heavily on retention of 6-8 green conifer trees/acre in harvest units. Retention of hardwood trees in harvest units would provide future hardwood snags and down logs.

<u>Down Logs</u>- Although the District RMP establishes interim guidelines for down log retention within regeneration harvest units, these guidelines are considered a minimum requirement until more accurate models are developed which establish specific down log retention levels for groups of plant associations or stand types. For most regeneration units harvested using the minimum retention requirements, down log volumes after treatment would likely be much lower than average values for naturally regenerated forests because a portion of class 3 -5 down logs are inevitably destroyed during the logging process. Minimum retention levels are approximately 18-95% of the level found in natural stands. If down log creation efforts are limited to future harvest units, it will take at least 60 years (one harvest rotation) to eventually meet down log targets on GFMA lands. It is possible to hasten the attainment of down log target levels on GFMA lands by either managing to exceed target levels in harvest units or creating down log habitat on other GFMA lands before they are subject to regeneration harvest.

Down log abundance is also probably critically low on reserve lands and will continue without aggressive down log creation efforts. The current lack of hard snags and down logs (and therefore, future down logs) creates a situation where it will be impossible to provide adequate soft down log habitat in the future.

<u>Rocky Habitats</u>
The larger rocky outcrops have never supported much tree cover that could offer shade. They have probably always been exposed to wide temperature/moisture fluctuations as they endured direct sunlight and wind exposure. Vegetation around talus and small rocky outcrops changed as fires and timber harvest set stands back to an early successional stage. For example, rocky habitats, which are common in the Bravo Creek area, were generally surrounded by early seral vegetation after the 1939 fire; these rocky habitats are now surrounded by mid-seral vegetation. This surrounding vegetation strongly impacts the microclimates that these rocky habitats offer to wildlife. Several species including bats, raptors, and woodrats utilize these habitats for roosting, nesting, or resting because of the special microclimates these habitats offer.

What is the current open road density, and how does it compare with goals from the RMP?

The current road density for the analysis area averages 3.6 miles/mile^2. The density of roads on BLM lands is substantially lower at 2.3 miles/mile^2 (Table F-1, Appendix F).

The RMP states that the goal for open road density in this portion of the District should be 2.9 miles/mile^2. Access into the analysis area is controlled and restricted by South Coast Lumber Company through a series of gates and, as access is restricted, these roads are technically closed. Therefore, open road density remains well below RMP guidelines; total road density on BLM lands is also below RMP guidelines.

According to South Coast Company policy, roads are open only to company/contractor personnel into current harvesting operations and to the general public for a short time period during fall deer hunting season. However, these roads still get substantial administrative use by the BLM and South Coast Lumber. The effectiveness of this type of road closure is definitely not as high as a road closed with a permanent barrier year round.

What is the function of the analysis area within the larger landscape? How does the LSR function in the larger LSR network?

Landscape Function - Reference Condition
Aerial photos from 1940 indicate that much of the southern third of the analysis area provided late-successional habitat. Much of the northern 2/3 was early successional and hardwood habitats and meadows with late-successional habitats primarily confined to stream sides. This dynamic, fire-influenced mosaic of late and early successional habitats undoubtedly supported many species associated with all these habitats. Given the proximity to the ocean and the current murrelet activity found in fragmented habitats, the area was likely a stronghold of murrelet nesting activity. The majority of the LSR has burned this century (Figure III-25).

Landscape Function - Current Condition
Since the analysis area is only 2-9 miles inland and on the edge of the main forest network on Forest Service land, it does not function as a critical dispersal or movement area for mobile, late-seral wildlife. Its proximity to the ocean does hold unique function for those few species, such as marbled murrelets, which use both inland and ocean habitats. Its function and significance are more local in scale in providing special habitat areas and populations of species on the western edge of their range. The analysis area provides important special habitat areas (such as rocky habitats and springs/seeps) and locally important wildlife populations which can contribute to the populations further inland.

The North Fork Chetco LSR (#251) is on the western periphery of the network of large LSRs. A large LSR in the Siskiyou National Forest is 2 miles east of the Chetco BLM LSR. Since LSR #251 is outside of the main LSR network, it does not contribute to connectivity between the large LSRs. As its primary function, LSR #251 provides habitat for species of local interest (e.g. California slender salamanders) and species that are ocean-influenced (e.g. murrelets). This small LSR also bolsters the function of its much larger LSR neighbor to the east by supporting reproducing late-successional wildlife species which then produce dispersing young to help populate the larger LSR. Approximately 40% of the murrelet habitat in the LSR has been surveyed and these surveys suggest a high probability that other habitat in the LSR may be occupied by murrelets.

Does the larger 5th field watershed meet the minimum 15 % retention requirement of late-successional habitat and where is it located?

Both the Northwest Forest Plan and Coos Bay's RMP require the retention of late-successional forests in fifth-field wartersheds "in which federal forest lands are currently comprised of 15 percent or less late-successional habitat". Late-successional forests are those seral stages that include mature (80 to 159 years old) and old-growth classes (160 years and older)(S&G B-1). The highest priority for retention should be the older age classes on those lands which have a 'reserve' designation (i.e., Late-Successional Reserve, Riparian Reserve, Administratively Withdrawn Reserve), followed by GFMA & Connectivity land use designations.

The Lower Chetco 5th-field watershed contains 10,970 acres of Federally managed lands and 15% of these (1645 acres) must be maintained in the late-seral condition. According to FOI and Forest Service information, the Lower Chetco 5th field watershed contains 3818 acres of late-successional habitat, 2638 acres of which are located in LSR or other Reserve areas (Table V-6). Therefore, the objective of retaining 15% of the federal land base in transition or old-growth habitat types will be met through the Reserve network.

Some inaccuracies have been noted in the FOI data. The analysis area contains stands listed as 50 to 70 years old, predominately in the tanoak cover type which resulted form historic fires. These stands commonly contain remnant stands of Douglas-fir upwards of 200 years old, which are not reflected in the data base. These stands are primarily located adjacent to streams. In addition, some stands listed as 1840 birth date are actually over 275 years old. Therefore, the amount of late-successional habitat may actually be slightly higher than shown.

Table V-6 Late-Successional Habitat Acreage - Lower Chetco 5th field Watershed

Land Allocation	Lower Chetco 5th field (10,970 total Federal* acres)			
	0 - 79 yrs	80 - 119 yrs	120- 159 yrs	160+ yrs
LSR & MM Reserves	1892 (17 %)	514 (5%)	182 (2 %)	-
Riparian Reserves**	1389 (8 %)	410 (4%)	1124 (10 %)	52 (<1%)
other withdrawals	768 (7 %)	71 (<1%)	260 (2%)	25 (<1%)
CONN	75 (<1%)	34 (<1%)	2 (<1%)	17 (<1%)
GFMA**	3028 (28%)	424 (4%)	694 (6%)	9 (<1%)
Totals	7152 (65%)	1453 (13%)	2262 (21%)	103 (<1%)

* This figure includes 9370 acres of BLM and 1600 acres of Forest Service Lands within the 5th field watershed. Forest Service lands are within an LSR.
** This figure reflects the Riparian Reserve acres within the BLM managed lands only.

For comparison purposes, the percentage of late-successional forest within the North Fork Chetco analysis area shown below in Table V-7.

Table V-7 Late-Successional Habitat Acreage - North Fork Chetco Analysis Area

Land Allocation	North Fork Chetco (9,262 total BLM acres)			
	0 - 79 yrs	80 - 119 yrs	120 - 159 yrs	160+ yrs
LSR & MM Reserves	527 (6%)	279 (3%)	182 (2%)	-
Riparian Reserves & other withdrawals **	2127 (23%)	481 (5%)	1384 (15%)	77 (<1%)
CONN	75 (<1%)	34 (<1%)	2 (<1%)	17 (<1%)
GFMA	2950 (32%)	424 (5%)	694 (9%)	9 (<1%)
Totals	5679 (61%)	1218 (13%)	2262 (24%)	103 (2%)

** The acreage within Riparian Reserves is calculated from an edited HYD coverage which allows for this calculation. This acreage does not account for additional streams which will be located upon field reviews or minor modification of riparian reserve widths on intermittent streams.

How has timber harvest under the Rescission Act affected the function of the LSR?

The 1995 Rescission Act timber sales removed approximately 72 acres of late-successional and other habitats from the LSR (Appendix D - Table D-3 for unit specifics). A District-wide Plan Evaluation was conducted to assess impacts of Rescission Act timber sales on the LSR network and the NFP. This plan evaluation found that "the difference between the effects of the Rescissions Act ... sales as harvested and the effects of these sales as analyzed in the FSEIS and anticipated in the ROD is not sufficient to alter the validity of the decisions in the RMP..." Similarly, in a REO review of Rescission Act sales, the REO "determined that the capacity of the regional Late-Successional Reserves and Riparian Reserves network to provide the Federal contribution to the recovery of NSO and marbled murrelet remains intact."

While the regional and District-wide impacts may not have been significant, locally unit 6 of the North Fork Chetco timber sale removed habitat that was probably occupied by marbled murrelets.

Landscape Function

Because of the impacts of Rescission Act sales and past harvest activities, only approximately 39% of the LSR currently provides late-successional habitat, which is probably much less than historically. Most LSRs are currently well below their potential to provide late-successional habitat. Late-successional habitat is still being harvested on Matrix lands before similar habitats have a chance to develop on LSRs. This situation creates a bottleneck in the next few decades for species dependent on late-successional habitats. This makes it imperative to facilitate development of late-successional habitat characteristics on existing mature habitats in Reserve areas to ease passage through this bottleneck. Similarly, facilitating development of these characteristics in early-successional stands in Reserve areas will decrease the time it takes to move through the bottleneck.

The importance of special habitat areas such as rocky outcrops and talus, seeps and wetlands and the microclimates they provide emphasizes the need to maintaining a variety of seral conditions around these microhabitats (i.e. don't have early seral conditions around most of the rocky outcrops at any one time period). At any one time in the past, a portion of the rocky habitats had varying ages of stands recovering from the affects of different fires. The proportion of seep and wetland habitats in stands affected by fires was probably less than that for rocky habitats because the moister conditions discouraged fires. Nonetheless, some were almost undoubtedly in early seral habitats.

What are the influences and relationships of key habitats with other ecosystem processes in the analysis area?

The cooler, moister microclimate around riparian areas moderated the effects of fire in these areas allowing development of late-seral habitats (refer to Section III.7 Disturbance). Klamath Province soils and geology provide the rocky habitats that are common in the analysis area (see Sections III.1 Geology and III.2 Soils).

What are the management objectives (desired condition) for the wildlife habitat in the analysis area? How should habitat types be arranged (spatially and temporally)?

LSR and Riparian Reserve areas should be dominated by late-seral Douglas-fir habitat. Nearly the full width of Riparian Reserves in the lower portions of drainages should generally be in late-seral habitat. Riparian Reserves in headwaters should contain narrower fingers of late-seral habitat along the streams with hardwoods more prevalent in the upslope portion of the Riparian Reserve. The LSR should also continue to contain areas of knobcone pine on appropriate soils along the ridge separating N. Fk. Chetco River from Ransom Creek.

Conifers should be restored in hardwood stands, particularly along streams on north and east slopes, where the conifers had been harvested out and never regenerated. This would begin to reconstruct the habitat patterns of the past and facilitate movements of wildlife associated with these habitats. On areas where hardwoods dominate because of fire disturbance, information on fire history (including whether it was a natural or human-caused fire) and historical species composition should be used to prioritize and evaluate individual projects. A higher priority should be placed on projects in areas that burned in human-caused fires and lowest priority on hardwood stands resulting from soil types and natural disturbances .

In southwestern Oregon coastal forests, fires have been re-occurring approximately every 90-150 years (Agee 1991). If this same schedule persisted, the area might be due for another large fire after the turn of the century. Considering that the next decade or two will be the "bottleneck" for the survival of many late-successional species, it may be prudent to postpone prescribed fire projects in mature/late-successional forests for restorative purposes for several decades.

Tanoak should continue to be a component of stands. Stands historically dominated by hardwoods or brush fields should generally be allowed to continue their hardwood/brush field seral stage trajectory to conifer strands. This will allow time for these stands to continue to produce nuts and seeds for wildlife. Some hardwood and mixed hardwood/conifer stands could be modified to increase the conifer component and meet the habitat needs of species associated with these habitats.

Open meadow habitat on BLM lands in the upper part of Ransom Creek and Morton Butte area should be re-established, where they have been encroached upon by trees. Portions of the analysis area should continue to support brush fields and knobcone pine where fire intensity and soils encourage these types of stands (Bosley Butte and upper Bosley Creek area). Rocky habitats in a variety of vegetation seral stages should be available.

Snags densities should support at least 40% cavity nester potential in harvest areas and at 100% cavity nester potential in Reserve areas. Forty percent potential equates to approximately 1.5 hard snags/acre and 100% equates to approximately 4 hard snags/acre.

V.3 TERRESTRIAL SPECIES

What are the species of concern in the analysis area including species associated with key habitats or habitat components? What habitats are they associated with?

The species of concern[2] were identified using the following criteria:

- Survey & Manage species (S&M) - the NFP recognized that these species were not sufficiently protected by other mitigation and that further protection was necessary.
- Protection Buffer Species (P) - the NFP identified specific protective measures for these rare and locally endemic species
- Special Status Species (SSP) - species listed as Threatened or Endangered under the ESA or listed as Bureau Sensitive species
- Riparian Reserve Species (RR) - species identified as benefitting from increased Riparian Reserve widths using the procedures described in the RR Module (see BLM Information Bulletin No. OR-96-162).
- Supplemental EIS Appendix J2 species (J2) - these species were considered in the Northwest Forest Plan but were not expected to fare well under the draft Option 9 FEMAT proposal; therefore, Option 9 was modified for the final EIS to better address these species. The species viability ratings however, were never formally reassessed.
- Local Concern (Local) - Species of local concern.
- Species were potentially affected by anticipated management actions.

Species of concern in the analysis area were determined based on the above criteria and present knowledge of the range of each species. Table V-8 lists the species of concern that were identified for the analysis area, along with the reason for their inclusion. Table V-9 lists the habitat associations of the species of concern.

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[2]The phrase "species of concern" is used to refer to the group of species for which special management concern exists in the analysis area (consistent with the use in WA Guide Ver 2.2) and is not to be confused with the species of concern list maintained by the U.S. Fish and Wildlife Service which is roughly analogous to the former Federal Candidate 2 species list.

Table V-8 Wildlife Species of Concern in the North Fork Chetco Analysis Area.

GROUP	SPECIES	REASON	COMMENTS
Amphibians	Foothill yellow-legged frog	ssp	
	Tailed frog	J2, RR, ssp	
	Southern torrent salamander	J2, RR, ssp	
	Del Norte salamander	S&M, P	
	California slender salamander	Local	small range, uncommon, local concern
Mammals	Red tree vole	J2, RR, S&M	
	White-footed vole	ssp	
Bats	Big brown bat	RR	
	California myotis	RR	
	Fringed myotis	J2, RR	
	Hoary bat	J2, RR	
	Little brown myotis	RR	
	Long-eared myotis	RR	
	Long-legged myotis	RR	
	Silver-haired bat	J2, RR	
Birds	Golden eagle	Local	uncommon in District, local concern
	Peregrine falcon	ssp	
	Great gray owl	S&M	may not occur in District
Reptiles	Sharptail snake	ssp	

Table V-9. Habitat Associations for Species of Concern.

Species	Primary Habitat Association	Secondary Habitat Association	Key Habitats/Features Affecting the Spp			
			Veg	Snags, Down Logs	Rock	Riparian
Foothill yellow-legged frog	stream (large)	rock				x
Tailed frog	river, stream	mature & late seral forest				x
Southern torrent salamander	stream, seep, spring	late seral forest				x
Del Norte salamander	talus	closed canopy forest, late seral forest	x		x	
California slender salamander	down log	closed canopy conifer forest	x	x		
Red tree vole	mature & late seral conifer forest	young seral conifer forest	x			
White-footed vole	riparian, hardwood (alder)		x			x
Big brown bat	snag, cave, bridge (roost) riparian, early seral, forest opening (feed)	late seral forest	x	x	x	x
California myotis	snag, cave, bridge, rock, late seral, hardwood (roost) riparian, early seral, forest opening (feed)	late seral forest	x	x	x	x
Fringed myotis	snag, cave, rock, bridge (roost) riparian, early seral, forest opening (feed)	late seral forest	x	x	x	x
Hoary bat	snag, cave, mature & late seral forest (roost) riparian, forest, forest opening (feed)	late seral forest	x	x	x	x
Little brown myotis	snag, cave, rock, bridge, late seral (roost) riparian, early seral forest (feed)	late seral forest	x	x	x	x
Long-eared myotis	snag, cave, rock, late seral (roost) riparia, forest, forest opening (feed)		x	x	x	x
Long-legged myotis	snag, cave, rock, bridge, late seral (roost) riparian, forest (feed)	late seral forest	x	x	x	x
Silver-haired bat	snag, cave, rock, late seral (roost) shrub & open forest, forest opening (feed)	late seral forest, riparian	x	x	x	
Golden eagle	shrub, grass/forb (feed) late seral (repro, resting)	cliff, snag (resting)	x	x	x	
Peregrine falcon	cliff (repro) riparian/wetland (feed)	closed canopy forest (resting) all seral stages (feed)	x	x	x	x
Great gray owl	late-seral forest, forest (nest) early & late-seral forest, meadow, edge (feed)		x	x		
Sharptail snake	down log, talus	grass/forb, early seral	x	x	x	

What was the historical and what is the current relative abundance and distribution of species of concern in the analysis area ?

Historical (reference) Condition

No historic data exists on the distribution or relative abundance of wildlife species of concern in the analysis area. Wide-ranging species intolerant of frequent disturbance such as wolverine and grey wolf were likely present in the Klamath Province; although they have been extirpated in historic time. All the wildlife species of concern were almost certainly more abundant and widespread historically. Habitat loss and fragmentation, human disturbance and hunting/trapping, and competition or predation from exotic species have all contributed to population declines. While many of these factors have been affecting populations for centuries, changes have been more pronounced in this century (since European settlement). Some species including Southern torrent salamanders, tailed frogs, peregrine falcons, golden eagle, northern spotted owls, white-footed voles, and red tree voles have probably experienced the most significant declines. Beaver were probably never common on BLM land in the analysis area because streams are generally too steep. The lower part of the North Fork Chetco River (on private land) contains some low-gradient reaches with potential for beaver.

Conversely, edge and disturbance-adapted species such as great horned owls, crows, ravens, and raccoons were probably less common than they are currently. Barred owls, opossums, and perhaps other species native to eastern U.S. have expanded their range or been introduced into the Klamath Province in historic time. Exotic species were not introduced until white settlers moved in during the mid-1800s.

<u>Current Condition</u>

Stream and Seep Associated Amphibians; Foothill yellow-legged frog, tailed frog, Southern torrent salamander - (refer to Section IV.3 Aquatic Species). Survey efforts for these species are limited to opportunistic surveys. No systematic inventories have been conducted. Foothill yellow-legged frogs occur in Ransom Creek, Bravo Creek, and N. Fork Chetco River. Habitat quality appears high (lot of rocks, pool habitats common). Tailed frogs occur in Ransom Creek, Mayfield Creek, and Bosley Creek and may occur in others.

Del Norte salamander - Del Norte salamanders are strongly associated with moist talus habitat (Nussbaum et. al. 1983). They feed on invertebrates near the surface during the wet, warm spring and fall periods, retreating deeper into the soil during other times of the year (L. Ollivier, pers. comm.). They must come to the surface to feed. Talus is especially common around rocky outcrops. Few surveys have been conducted although they are known to occur on BLM land along the N. Fork Chetco River, Ransom Creek, and in the Morton Butte area. High quality habitat is common in many areas of the analysis area and the salamanders are also likely widespread and common. Cursory surveys in the analysis area and in a similar area a few miles north suggest Del Norte salamanders are the most common upland salamander.

California Slender salamander - These salamanders are strongly associated with down logs, have a small range, and are generally restricted to the narrow coastal belt in southwest Oregon and northwest California. They often use rodent burrows to retreat underground during the dry season (range and life history information summarized in Blaustein et. al. 1995). Few surveys have been conducted, but they are known to occur in one location along Jim Ray Creek. Cursory surveys suggest these salamanders are present, but uncommon in the analysis area. The large down log habitat that these salamanders occur in seems scarce but may be more common in the southern half of the analysis area where soils and fire history facilitated development of large conifers and retention of down wood.

Voles - <u>Red tree voles</u> are arboreal rodents that occur in patchy distributions primarily in late-successional forests (Huff et al. 1992). Possible nest structures have been noted in 40-13-4 & 5, and 39-13-19. Using habitat definitions if the draft red tree vole protocol (BLM Instruction Memorandum No. OR-97-009, dated 4 Nov. 1996), approximately 35% of BLM land in the subwatershed is suitable habitat for red tree voles. Combining BLM data with Forest Service data for the whole Chetco River system, at least 51% of federal lands meet suitable habitat definitions (assumed Forest Service land with mid and late-seral/climax stands meet habitat conditions). The proper scale for habitat analysis, according to draft protocol, is this 5th field/watershed level. The Siskiyou National Forest compiled a GIS analysis of habitat condition and found that all their watersheds were above habitat thresholds, even without counting habitat from the relatively small acreage of BLM land which occurs in some of the watersheds along their west edge (Lee Webb, pers. comm.); therefore, habitat conditions appear to be above the 40% habitat threshold identified in the protocol, and surveys prior to ground disturbing activities are not required.

The white-footed vole inhabits riparian areas, particularly along small streams with an alder forest component (Maser, et al. 1981). This rare vole has been documented in the district, but few surveys have been conducted. Their preferred habitat, alder riparian areas, occurs in the analysis area, particularly in areas recovering from landslides or debris torrents (see Sections III.5 Erosion Processes and IV.4 Riparian Habitat). Both species of vole are susceptible to habitat loss and fragmentation.

Bats - Bats are associated with a variety of habitat structures. Bats roost in buildings, bridges, rock crevices, tree cavities or foliage, and loose tree bark. Old growth forests provide higher quality roost sites than younger forests (Christy and West 1993). Foraging areas include the forest and forest openings, riparian areas, and open water. No surveys have been conducted for bats in the analysis area. Rocky outcrops and boulders for roosting are common in the analysis area; large conifers with deeply fissured and loose bark for roosting also occur along many streams. Only a few rocks bluffs have been casually surveyed for bat roosting habitat potential; suitable roosting crevices were noted in many of the rocks.

Golden Eagle - Golden eagles nest in large trees, snags, or cliffs and forage in meadow and shrub habitats. Golden Eagles are not common in the Coos Bay District. Only 1-2 nest sites are known. Foraging habitat is relatively scarce except in agricultural areas adjacent to BLM land. A pair of golden eagles has been seen on several occasions during the nesting season in recent years in the northern half of the analysis area suggesting that a pair may be nesting, although the exact location is unknown. Suitable nesting habitat exists on BLM land and foraging areas occur on the pastures and agricultural areas on nearby private land.

Peregrine Falcon - In 1988, biologists conducted an inventory of potential nest cliffs using aerial surveys. Cliffs with low to medium nesting potential (based on the availability of suitable nest platforms, cliff height, and proximity to water) are located at Cassidy Butte and on cliffs along Bravo Creek. Colegrove Butte received a medium to high nesting potential rating. Not all cliffs were inventoried. Several other high-potential nesting cliffs occur along the coastline only a short distance away (for a falcon). The BLM monitored the Bravo Creek cliff for nesting falcons in 1993 and 1994; no peregrines were detected. Peregrine falcons forage over riparian areas and a wide variety of other habitats including coastal habitats. The analysis area holds high potential for nesting and foraging falcons.

Great Gray Owl - Great gray owls generally nest in unlogged mature and late-successional conifer forests. They forage in meadows or other openings or in open forests [life history information summarized in the Great Gray Owl Survey Protocol (1995)]. Although they were thought to be a high elevation species found above 3000 feet, they have recently been found nesting at 1700 feet on lands administered by Medford BLM. The analysis area contains 1290 acres above 2000 feet in elevation; although most of this is knobcone pine stands unsuitable for great gray owl habitat. They are not known nor suspected to occur in the District. Surveys last season on Siskiyou National Forest lands east of the analysis area did not turn up any great gray owls (Dave Austin, Siskiyou NF, pers. comm). Recent adjustments to the protocol recommend surveys be conducted on the Coos Bay District to determine whether or not great gray owls occur in the vicinity (BLM Info. Bulletin No. OR-97-311). Since meadows (potential foraging habitat) and late-successional forests (potential nesting habitat) are relatively common in the analysis area compared to other areas on the District, the analysis area may hold higher potential for great gray owl occupancy.

Sharptail Snake - Although no sharptail snakes have been found in the analysis area (no surveys ever conducted), these snakes could occur in a variety of conifer and hardwood forest, meadow, pasture, and brushland habitats. They are often found in moist areas near streams, under down logs or bark, or in talus (life history information summarized in Blaustein et. al. 1995). They are frequently found in association with talus or rocky outcrops and with conifer/hardwood/grassland edges (which are common in the analysis area).

How have management activities and natural processes changed the abundance, distribution, and movements of these species or the character of their habitats?

Del Norte salamander

Fires certainly affect Del Norte salamanders and their habitats, but the exact effects are probably highly variable depending on the timing and intensity of the fire. Natural fires occurred during the summer dry season when Del Norte salamanders are under ground, so the fires probably never directly killed many salamanders. Fire's primary effect was through its effect on canopy cover. Welsh and Lind (1995) found that high canopy cover was very important to Del Norte salamanders. Low intensity fires left patches of forest unburned. These unburned areas could have been refugia from where Del Norte salamanders could have repopulated adjacent areas after canopy cover increased post fire. Brush species can quickly reach 100% cover in less than 10 years. High densities of snags and dying trees left after a low intensity fire could have provided some marginal canopy cover allowing Del Norte salamanders to persist in areas after fires. Since large fire events probably removed canopy cover from many areas every 90-150 years or so (refer to Section III.7-Disturbance), Del Norte salamanders were probably always in a mode of recovery and recolonization of new or marginal habitats. Information as to the ability of Del Norte salamanders to survive and recolonize an area could possibly be found by conducting surveys in the Bosley Butte area. Species of concern in the analysis area were determined based on the above criteria and present knowledge of the range of each species. Table V-8 lists the species of concern that were identified for the analysis area, along with the reason for their inclusion. Table V-9 lists the habitat associations of the species of concern. where over 7000 acres burned intensely.

In contrast to natural fires, fire for site preparation on harvest units typically occurs during the moist spring and fall periods when Del Norte salamanders are active at the surface; hence, broadcast burning site preparation may kill many individuals. Timber harvest and road building also remove canopy cover and fragment habitat rendering it less suitable for the salamander.

California slender salamander

The frequent fires of the early 1900's and more recent timber harvest and salvage probably removed much of the natural down log habitat that California slender salamanders depend so heavily on. Harvest in the 1950's- 1970's sometimes consisted of high grading the large conifers from along creeks. These large conifers would have been the habitat for California slender salamanders today. The greater prevalence of large conifers in the southern half of the analysis area probably provided the best habitat for these salamanders historically, but this is also where most of the harvest has occurred (especially on private land).

Voles

Red tree voles occur most commonly in old-growth conifer forests and eat conifer needles exclusively (Carey 1991). In the analysis area, conifers often occur in linear strips along streams. Harvest often removed or at least broke these conifer corridors thereby removing and fragmenting the preferred habitat for red tree voles. Timber harvest reduced habitat quality and quantity for red tree voles (removed old-growth conifers and replaced them with young conifers or hardwood). Timber harvest has also fragmented habitat (reduced connectivity) by breaking linear patches of old-growth conifers along creeks.

Bats

Many of these bat species roost in bark fissures and loose bark which are most common on large Douglas-fir trees. Sixty one percent of the analysis area has been harvested thereby reducing availability of this roosting habitat. Many of the bat species also use rock cracks for roosting. The availability of rocky outcrops is not changing but the habitats around them are; therefore, the microclimates that they offer are changing too.

Golden Eagle

Even though timber harvest has removed nesting habitat for golden eagles (large trees and snags), nesting habitats for these mobile birds are still available in the northern half of the analysis area where the golden eagles have been seen. Management activities on adjacent private land (development and maintenance of pastures) has provided foraging areas for these eagles. Specific management activities such as timber harvest, prescribed burning, road construction, etc. could disrupt a year's reproductive effort if it occurs close enough to the golden eagle's nest by disturbing the nesting activities.

Peregrine Falcons

Foraging and nesting habitat conditions, while changed from historic conditions, probably have not been reduced. Specific management activities such as timber harvest, prescribed burning, road construction, etc. could disrupt a year's reproductive effort if it occurs close enough to a nesting cliff by disturbing the nesting activities.

Great Gray Owls

If great gray owls occur in the analysis area, tree planting and encroachment on meadows would have reduced foraging opportunities. Timber harvest and salvage reduced nesting opportunities.

Sharptail Snake

This snake's dependence on moist surface conditions under cover objects such as down logs, loose bark, and talus suggest that maintenance of shade (canopy cover) in streamside habitats (in Riparian Reserves) where microclimates favor cooler, moister conditions might be particularly important for sharptail snakes. Past harvest activities often focused on the large conifers available along streams suggesting habitat conditions for these snakes might be reduced. Sharptail snakes also use rocky outcrop areas as habitat, again suggesting that maintaining shade and cooler, moister microclimates around these structures is important.

What are the influences and relationships of species and their habitats with other ecosystem processes in the analysis area?

Del Norte salamander

Soils and geology exert a heavy influence on the abundance and distribution of Del Norte salamanders because of their direct influence on talus habitat. Fires, road building, timber harvest, and other ground disturbing activities can degrade habitat quality or destroy it and can also directly kill individuals (especially spring and fall burns).

California Slender salamander

Low-intensity fires can kill trees without drastically reducing canopy cover. These fire-killed trees will eventually provide down log habitat. (Refer to Section V.2, discussion on Snags and Down Logs). Timber harvest removes trees which would have eventually been down log habitat.

Voles

Fires, while destroying habitat, often left corridors of connected habitats along streams. These same fires, along with more productive soils, left more habitat in the southern half of the analysis area. (Refer to Section III.7-Disturbance).

Bats

Refer to Section V.2, discussion on Rocky Habitats, Snags and Down Logs.

Golden Eagle

Soils and geology determine the size, shape, and distribution of cliffs which are sometimes used by golden eagles for resting or nesting.

Peregrine Falcons

Soils and geology determine the size, shape, and distribution of cliffs which are used by peregrine falcons for nesting.

Sharptail Snake

Low-intensity fires can kill trees without drastically reducing canopy cover. These fire-killed trees will eventually provide down log habitat and loose bark used by sharptail snakes for cover (refer to Section V.2, discussion on Snags and Down Logs). Soils and geology determine the distribution and character of rocky habitats which are also commonly used by sharptail snakes.

What is the management objective (desired condition) for the wildlife species in the analysis area?

Maintain populations of species associated with early, mid, and late-seral conditions as well as species associated with various special habitats. Mid and late-seral species will primarily reside in the LSR and southern half of the analysis area and in Riparian Reserves. Species associated with cool or moist talus and rocky habitats will generally reside in the southern half of the analysis area. Early seral, meadow species (golden eagle, sharptail snake, great gray owl) will generally find habitat in the northern half of the analysis area; although mid and late seral forests should be available in Riparian Reserves and other Reserves in the northern area as well (for perches, down logs, snags, nesting areas).

V.4 PORT-ORFORD-CEDAR ROOT ROT

Phytophthora lateralis, Port-Orford-cedar root rot, was unintentionally introduced in the northwest as early as 1923 and has caused 100% mortality in some cases. The spores of the fungus, being highly mobile in water, travel downstream infecting previously uninfected areas. Spores also are transported by construction equipment, vehicles, human and animals.

What is the current distribution and level of infestation of Port-Orford-cedar root-rot in the analysis area?

Port-Orford-cedar (*Chamaecyparis lawsoniana*) (POC) is an exceedingly minor component of the forests within the analysis area. Riparian habitat surveys along Bravo, Ransom Creeks did not locate any POC adjacent to these streams. Similarly, a systematic survey of roads within the analysis area did not locate any POC. However, review of records from all the BLM timber sales sold since 1966 revealed that only 1 POC tree was cruised as part of the sales, and that particular sale was located on the western most edge of the analysis area.

The systematic road survey did locate nine locations of POC trees immediately outside of the analysis area. These sites were associated primarily with residential dwellings adjacent to county roads and three of these sites were suspected as being infected with the disease.

What is the potential for the continued introduction and spread of the disease?

The potential exists for humans, animals, equipment, and vehicles to transport infected soil into the analysis area. However, the opportunity for infection within the analysis area is extremely remote for the following several reasons; there is a lack of host trees, surveys have not found any POC adjacent to forest roads, and most access is restricted into the analysis area. Of possible concern is that a few infected sites are located along public roads and may serve as an potential source of infection to other areas outside the analysis area. However, once the single trees or small clumps die out they will no longer serve as a source of infection. The fungal spores survive only 4 - 7 years in the soil without a host tree to perpetuate itself (BLM 1994).

What ecological processes would be altered should POC be lost, or populations greatly reduced in the ecosystem?

Because POC is virtually absent from the analysis area , the loss of POC in not an issue.

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?

Due to the lack of POC in the analysis area, no management actions to prevent infection are necessary.

V.5 NOXIOUS WEEDS

Noxious weeds and other exotic vegetation did not exist until after white settlement began in the area. Most exotic species were introduced into southern Oregon during the late-1800's to mid-1900's and have since spread from their source of introduction. Therefore, it may have taken many years for these species to reach this analysis area. Some of these species did not establish themselves until more areas were disturbed by human activities and propagules were transported in from infested areas.

Exotic species comprise approximately 20% of the analysis area flora (43 species). Most of these have been purposely introduced for various reasons and are associated with roads and disturbed areas. While most of the introduced vegetation does not persist over a period of time, some species, such as orchard grass (*Dactylis glomerata*), blackberry (*Rubus* sp.), and tall fescue (*Festuca arundinacea*) have the ability to spread and potentially displace native vegetation

What is the current status of the spread of noxious weeds in the analysis area?

Currently, noxious weeds are known throughout the analysis area, but at this time appear to generally occur as scattered populations primarily adjacent to roads in disturbed areas.

Gorse (*Ulex europaea*) has been documented adjacent to Road No 40-13-11.2 in the Palmer Butte area. A couple of plants were found next to utility poles installed to supply power to the communications site. The plants have been removed and the site is being monitored for re-occurrence. Two additional plants were located adjacent to Road No. 40-13-11.3 immediately to the east of the analysis area. These plants were pulled in 1997 and will be monitored for re-occurrence.

One large occurrence of Scotch broom (*Cytisus scoparius*) occurs on private lands at the southernmost entrance along South Coast's mainline 1000-line road outside of the analysis area. This may serve as a source point or the transport into the analysis area. However, vehicle access by other than company and BLM personnel is restricted and the potential rate of spread should be small.

Locations of tansy ragwort (*Senecio jacobaea*) and Klamath weed (*Hypericum perforatum*) are unknown, but populations generally consist of such low numbers that inventories have not been conducted. Also, these species are effectively controlled by biological agents and are deemed at levels where they do not pose any resource risks.

What is the ecological impact of noxious weeds?

Noxious weeds have the ability to out compete and possibly eliminate native vegetation by competing for water, sunlight, soil nutrients, and space. The two broom species and gorse have the ability of fix-nitrogen (i.e. able to take it out of the air) therefore they are able to establish on nutrient poor (disturbed) sites. This adaptation also gives these plants an advantage over native species. Indirectly, these species may impact wildlife species (if infestations become large) by creating less desirable forage and reducing habitat quality. Very few wildlife species appear to utilize these species.

Broom species and gorse have seeds which can remain dormant for many years (possibly up to 70-80 years, if under optimum conditions). Therefore, if areas are infested following logging, there is a likelihood that these species could eventually disappear (when canopy reaches closure) only to reestablish once the stand is logged in the future. This is more likely to occur in stands with shorter rotations (60-80 years), such as matrix and private lands.

Without any management, weed populations will increase in the future, primarily along road corridors. Besides the infestations within the analysis area, there is the possibility of spreading weeds into and from adjacent watersheds.

What is the potential of noxious weeds to spread and impact the analysis area?

The small size and scattered distribution of infected sites indicate that these areas are still treatable at the current time. However, of key concern is that these areas are on private lands and located along a main access road into the analysis area. A factor which may slow the rate of spread, is that access to a majority of the area is controlled by a private timber company, which does not allow the general public to drive onto their lands. This reduces the number of vehicles and lessens the chances of introducing seeds.

Several gorse and scotch broom plants were recently discovered and pulled from BLM lands in the Palmer Butte area. The significance of this is that this area is located adjacent to the Gardiner Ridge County Road along the east boundary of the analysis area and has the potential to have seeds carried through this and adjacent watersheds. The Palmer Butte site is being monitored for recolonization.

It is likely that new weeds may become introduced (either unintentionally or intentionally) in this and other watersheds in the future.

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?

The goal for noxious weed management is to contain noxious weeds populations so they do not pose a risk to resources. Currently, the level of infection lends itself to efficient control to remove these species from this analysis area, if action is undertaken promptly. The further introduction of non-native plant species should be kept at a minimum.

VI RIPARIAN RESERVE EVALUATION

This Section of the watershed analysis is intended to address the need to conduct certain management activities within Riparian Reserves. The *Riparian Reserve Evaluation Techniques and Synthesis; Supplement to Section II of Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis* (RRE-Supplement) sets forth data needs to be addressed at the watershed analysis level. Depending upon the extent of management activities, the *RRE-Supplement* recommends different depths of analysis. This Section is intended to fulfill the recommendations for a Level 1 Riparian Reserve Evaluation, which is geared toward small management actions within Riparian Reserves or a small percentage change in reserve acres associated with intermittent streams. This level of analysis limits the magnitude of activities within Riparian Reserves to the following:

> 1.) The amount of Riparian Reserve acreage proposed for 'management'[3] within the analysis area does not exceed 84 acres (10 % of the area delineated by intermittent Riparian Reserves).
>
> 2.) The Riparian Reserve width for any given non-fish bearing intermittent stream is not to be reduced below 90 feet (one-half of a site-potential tree).

A Level 1 analysis involves identifying the vulnerability of Riparian Reserve-associated species of concern for the analysis area (Tables VI-1 and VI-2). These tables, as well as the accompanying risk assessment (Tables VI-3 and VI-4), can be used in future site-scale level analysis (NEPA) or a Level 2 Riparian Reserve Evaluation.

How may acres of Interim Riparian Reserves are in the analysis area? How many acres of riparian Reserve are associated with intermittent streams?

For the North Fork Chetco analysis area, the GIS database indicates that interim Riparian Reserves occupy approximately 2,944 acres (32%) of the BLM-managed land (Table I-1), based on a site-potential tree height of 180' (site-potential tree calculation in Appendix E-1). It should be noted that this acreage is an estimate; sources of error include unmapped streams and the difference between the actual location of the interim Riparian Reserve boundary (based on slope distance) and the computer-generated boundary (based on horizontal distance).

The extent of water-dependant vegetation may be used to delineate Riparian Reserves. However, it is highly unlikely that riparian vegetation would extend beyond one-quarter site-potential tree height in the analysis area. The inner gorge may also be used to delineate Riparian Reserve boundaries. The inner gorge is defined as the first slope break above the active channel margin and terraces. In the analysis area the inner gorge often extends beyond one site-potential tree.

[3] For the purpose of acreage calculations, 'management activities' are best defined as; a change in Riparian Reserve widths, timber harvest or salvage, road construction, and those activities potentially inconsistent with the Standards & Guidelines (I.M. OR-95-123)

An initial stratification process to identify intermittent channels (Figure VI-1) indicates that approximately 19 miles of intermittent streams are located on BLM lands. This equates to 840 acres of Riparian Reserve (9% of BLM-managed land in the analysis area) adjacent to intermittent streams.

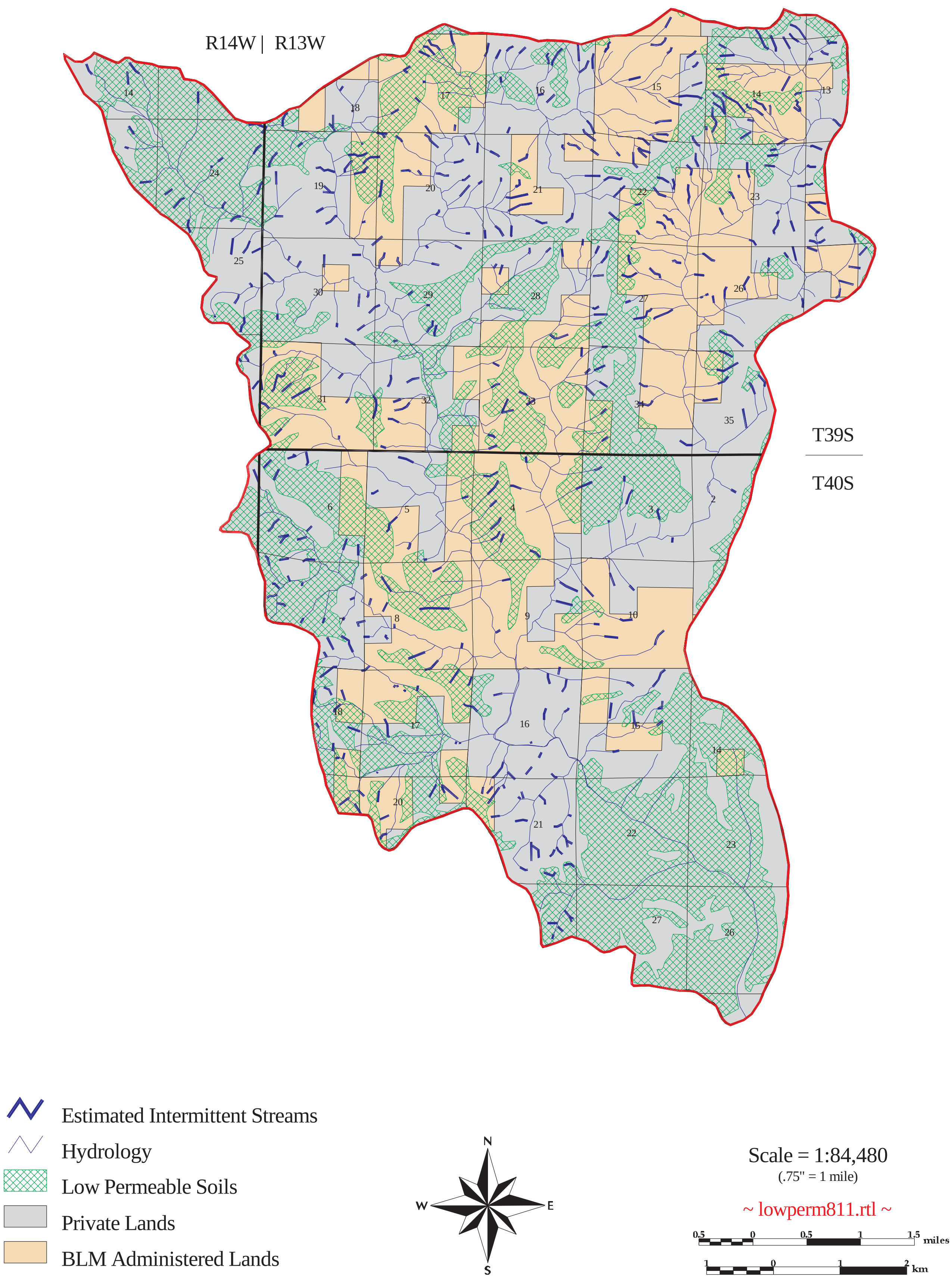
What factors are used to determine intermittent vs. perennial streams?

The spatial position, zone of intermittent/perennial flow and length of intermittent streams were estimated by modeling summer flow recession in small headwater channels throughout the analysis area. Attributes from the Curry County Soil Survey GIS coverage relate table were queried and used to create a mapped estimate of low permeability and deep soils areas. Figure VI-1 shows that a large portion of this area forms ridgetops and broad, upper sideslopes. These soils have lower hydraulic conductivities (<2 inches/hr.), and high porosities (55-60%). More water is stored in the winter as near surface groundwater and released more slowly over the summer months. Nearly all lands located outside the low permeability soil designation have moderate permeabilities and shallower depths.

Differences about permeabilities, soil depths and other soil characteristics were used in a groundwater flow equation to determine how fast water moves through the soil. National Weather Service data for Brookings, OR shows there is an average dry period of about 188 days between May and the end of October. During this period near surface water in soil horizons will travel a distance downslope determined by soil characteristics, geology and Darcy's Law of groundwater flow. The point at which small headwater channel drainage areas "dry down" could reasonably be assumed to support saturated soil conditions and perennial flow. The contributing drainage areas was assumed to be a 120 degree pie shaped arc. Water in lower permeability soils for very small drainage areas, was assumed to recede under channels as summer progressed. However, this water is thought to be forced up and appear as surface flow at the contact with shallow depth, higher permeability soils, or intersect the water surface where the drainage area became too large. By model estimates small drainages on low permeability soils would need a drainage area of 2-10 acres and moderate permeability soils, would need a 10 acre drainage area to support perennial flow in late summer. Based on this analysis, 47 miles of streams are estimated to be intermittent (19 miles on BLM managed lands), representing 38% of 1-2nd order small channel stream density (Table III-1). No confidence bounds have been established for this procedure and needs some verification during the low flow period. Because of modeled parameters and similar groundwater flow recession modeling in other watersheds with late summer field verification the estimate is thought to be slightly conservative or underestimating intermittent channel density.

Intermittent streams in the analysis area tend to be 1st order, high gradient (>10%), low sinuosity, entrenched channels, with low width/depth ratios and bedrock, boulder, cobble, gravel, and/or sand substrates. This description fits A1a, A2a, A3a, A4a, and A5a stream types (Rosgen 1994). Other 1st order streams in the analysis area are more likely to be perennial because the deep, fine-textured soils surrounding these channels store large volumes of water, have low permeabilities, and drain slowly. This would correspond to A6a stream types.

Figure VI−1 Estimated Intermittent Streams & Low Permeability Soils (< 2 inch/hr)



A perennial stream is "a stream that typically has running water on a year round basis" (FEMAT 1993). Alternate definitions include "a perennial stream or stream reach has measurable surface discharge more than 80 percent of the time. Discharge is at times partly to totally the result of spring flow or ground-water seepage because the streambed is lower than surrounding ground-water levels" (Meinzer 1923). Well-formed, adjustable channels have continuous channel boundaries and several distinct in-channel features. Fluvial action of sufficient duration (i.e., stream flowing year-round in most years) will carve a low flow channel. This is the so-called inner-berm, and is really a slight depression in the channel bottom which carries the minimum streamflow. Streams that have ponding, such as beaver dams, very coarse substrate, or that flow over bedrock will lack this feature. This cross-section dip is observable in most alluvial channels, but may be somewhat absent in steep juvenile channels. In the analysis area, 127 miles of stream is estimated to be perennial (73% of all channels). However, late summer flow in many of these channels may have “dry” spots and very low water volumes (barely noticeable).

The Myrtlewood hydrologist provided the following interpretations of the terms used in the Northwest Forest Plan definition of intermittent streams:

- To be a nonpermanent drainage feature, the stream should have a streamflow duration of less than 80% of the time.

- A definable channel should have some minimum depth of incision. The channel should be able to convey streamflow, and be essentially continuous. A definable channel can exist even though large organic debris may at times be lying in the channel or partially obscuring the channel.

- Annual scour or deposition usually is evidenced with distinct physical features. This may include: a stream scour line on the edges of the active channel, sediment accumulations behind obstructions in the channel, substrate in the channel more rounded than angular, and evidence of bankcutting on the outside of bends.

Biological criteria are useful in distinguishing between perennial and intermittent streams, and in determining the upstream terminus of perennial surface flow. The presence of aquatic invertebrates with protracted larval histories (> 1 year) (*Lara avara, Juga spp., Philocasca rivularis*), or larval amphibians (tailed frogs, Southern torrent salamanders, Pacific giant salamanders), strongly indicate perennial flow or persistent moisture sufficient to support biota associated with the perennial condition.

Final determination of intermittent streams will be made in the field, based on the following definition and supporting criteria:

> Intermittent streams are defined as any nonpermanent drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria (FEIS ROD, p. B-14). Biological criteria will also be used to help define the boundary between intermittent an perennial flow.

What are the species of concern present in riparian systems in the North Fork Chetco analysis area? What is their relative abundance and distribution?

The *RRE-Supplement* lists procedures to identify species of concern dependant upon the Riparian Reserve network. The list of species of concern was compiled from the following information located in Appendix E:

> List 1 - species analyzed in FEMAT and the FSEIS that were expected to benefit from increased Riparian Reserve protection;
> List 2 - species analyzed in FEMAT that were expected to benefit from Riparian Reserve protection;
> List 3 - species of local concern.

Table VI-1 lists the species of concern for Riparian Reserves grouped by their ecological classification and geographical distribution. Species in the shaded portion of the table are considered of greatest management concern and may require further assessment at the site-scale analysis. Those species in the shaded portion, as well as other 'flagged' species, have been carried forward for further analysis in Table VI-2.

Table VI-1 Ecological classification of riparian species of concern for preliminary vulnerability assessment.

	Localized & Rare	Widely Distributed & Rare or Localized & Common	Widely Distributed & Common
Exclusive & Restricted	**BRYOPHYTES** Kurzia makinoana **AMPHIBIANS** Southern torrent salamander **MAMMALS** White-footed vole **INVERTEBRATES** Redwood juga	**BRYOPHYTES** Scouleria marginata Plagiochila satoi Racomitrium aquaticum **VASCULAR PLANTS** Erythronium revolutum **AMPHIBIANS** Tailed frog **FISH** Coho salmon **INVERTEBRATES** Beers's false water penny beetle Burnelli's false water penny beetle	**BRYOPHYTES** Douinia ovata **AMPHIBIANS** Foothill yellow-legged frog Red-legged frog Northwestern salamander Rough-skinned newt Dunn's salamander **MAMMALS** Little brown myotis **FISH** Fall chinook salmon Winter steelhead Coastal cutthroat trout Pacific lamprey

(continued)

	Localized & Rare	Widely Distributed & Rare or Localized & Common	Widely Distributed & Common
Exclusive & Broad		**MAMMALS** Beaver **INVERTEBRATES** Montane bog dragonfly Denning's Agapaetus caddisfly	**BRYOPHYTES** Antitrichia curtipendula **BIRDS** Common merganser Lesser scaup
Supplemental & Restricted	**VASCULAR PLANTS** Iliamna latibracteata **AMPHIBIANS** California slender salamander Del Norte salamander	**FUNGI** Sarcosoma mexicana *Rare Gilled Mushrooms* Clitocybe subnitopoda **LICHENS** *Riparian Lichens* Collema nigrescens Platismatia lacunosa Ramalina thrausta Usnea longissima *Decaying Wood* Cladonia umbricola Icmadophila ericetorum **VASCULAR PLANTS** Adiantum jordanii **MAMMALS** Red tree vole Western red-backed vole	
Supplemental & Broad		**VASCULAR PLANTS** Allotropa virgata **BIRDS** Pileated woodpecker Northern spotted owl Marbled murrelet **MAMMALS** Fringed myotis Hoary bat Marten Fisher	**FUNGI** *Moss Dwelling Mushrooms* Galerina atkinsoniana Galerina cerina Galerina hetrocysis Galerina vittaeformis Rickenella setipes *Mycorrhizal* Gomphus clavatus Gomphus kauffmanii **LICHENS** *Forage* Alectoria sarmentosa Bryoria capillaris Bryoria glabra *Rock* Pilophorus acicularis **MAMMALS** Big brown bat California myotis Long-eared myotis Long-legged myotis Silver-haired bat

What is the species-habitat relationship for the vulnerable species of concern?

The *RRE-Supplement* recommends classifying Riparian Reserve habitat into seven ecological functional groups. Table VI-2 summarizes habitat associations for vulnerable species of concern which required further analysis (i.e., vulnerable species were those within shaded blocks carried forward the previous Table VI-1 and other previously "flagged" species).

Table VI-2 Habitat associations for *vulnerable* species of concern known or suspected to occur in North Fork Chetco analysis area.

		Habitat Associations							
Species	ACS or S&M	Late-Successional	Riparian	Aquatic - Lotic	Aquatic - Lentic	Seeps, Springs	Rock, Talus	Down Logs	Snags
PLANTS									
BRYOPHYTES									
Douinia ovata	S&M	X	X						
Kurzia makinoana	S&M		X						
Racomitrium aquaticum	S&M		X						
Scouleria marginata	S&M			X					
Plagiochila satoi	S&M	X	X						
FUNGI - Rare gilled Mushrooms									
Clitocybe subnitopoda	S&M	X							
FUNGI -Moss Dwelling Mushrooms									
Galerina atkinsoniana	S&M	X	X						
Galerina cerina	S&M	X							
Galerina hetrocysis	S&M	X	X						
Galerina vittaeformis	S&M		X						
Rickenella setipes	S&M		X						
FUNGI - Mycorrhizal									
Gomphus clavatus	S&M		X						
Gomphus kauffmanii	S&M	X							
LICHENS - Riparian									
Collema nigrescens	S&M	X							

		Habitat Associations							
Species	ACS or S&M	Late-Successional	Riparian	Aquatic - Lotic	Aquatic - Lentic	Seeps, Springs	Rock, Talus	Down Logs	Snags
Ramalina thrausta	S&M	X	X						
Usnea longissima	S&M	X	X						
LICHENS - Decaying Wood									
Cladonia umbricola		X							
Icmadophila erictorum		X							
LICHENS - Forage									
Bryoria capillaris		X							
VASCULAR PLANTS									
Adiantum jordanii		X	X						
Allotropa virgata		X							
Erythronium revolutum		X	X						
Iliamna latibracteata		X	X						
INVERTEBRATES									
Beer's false water penny beetle	ACS		X	X					
Burnelli's false water penny beetle	ACS		X	X					
Montane bog dragonfly	ACS		X		X	X			
Denning's Agapaetus caddisfly	ACS		X	X		X			
Redwood juga (*juga orickensis*)	ACS		X	X		X			
AMPHIBIANS									
Southern torrent salamander	ACS	X	X	X		X			
Tailed frog	ACS	X	X	X		X			
Del Norte salamander	S&M	X					X		
California slender salamander		X						X	
FISH									
Chinook salmon (fall)	ACS			X					
Coho Salmon	ACS			X					

		Habitat Associations							
Species	ACS or S&M	Late-Successional	Riparian	Aquatic - Lotic	Aquatic - Lentic	Seeps, Springs	Rock, Talus	Down Logs	Snags
Winter steelhead	ACS			X					
Pacific lamprey	ACS			X					
Coastal cutthroat trout	ACS			X					
MAMMALS									
Bats, general		X	X	X	X	X	X	X	X
White-footed vole			X						
Red tree vole	S&M	X							

What are the primary biological and physical values associated with Interim Riparian Reserves in the North Fork Chetco analysis area?

Refer to Section IV.2-Aquatic Habitat for detailed discussion of ecological values of riparian zones in North Fork Chetco and the effects of various management activities on these values.

Riparian Reserves are designed to protect physical and biological values (described in the ACS objectives) which are associated with riparian areas as well as to benefit upland species. These physical and biological values include:

- *Structural Complexity*-Riparian zones are characterized by assorted physical processes such as earth movement, deposition, erosion and different fire regimes which create an array of vegetative layers, including standing and down wood, snags, etc. Streamside vegetation often offers a structural contrast to upland habitats within the Riparian Reserves.

- *Diverse Array of Soil Moisture Conditions*-Riparian zones typically contain a diverse mosaic of surface soil conditions which vary in time and space.

- *High Plant and Animal Diversity*-Diversity and complexity of habitat features combined result in high native plant and animal species diversity. Additionally “soft” edges characterizing interface between upland and riparian forest and “hard” edges defining interface between riparian vegetation and stream channel promote riparian species diversity as does the proximity of water and riparian and upland habitats.

- *Sediment Regime*: Riparian trees promote slope stability, most notably along the inner gorge and in other unstable areas. In addition, riparian vegetation moderates the rate of sediment input into stream channels by filtering fine sediments from upslope.

- *Water Quality*- Riparian zones maintain and restore water quality through interception of sediments and nutrients, and through the moderation of solar radiation.

- *Water Quantity and Delivery*- Riparian zones in the analysis area have little value for water storage and delivery. Steep hillslopes and the lack of floodplains offer few sites for water storage.

- *Connectivity and Interspersion of Habitat Features*- Riparian ecosystems have a linear form, providing connectivity across the landscape. In addition to providing protective pathways for riparian-associated animals, riparian zones facilitate dispersal between widely dispersed upslope habitat areas by serving as "stepping stones" for animals dispersing between LSRs or across the landscape. Riparian Reserves support two functions for connectivity:

    1. Landscape scale - Facilitating the movements of mobile species associated with late-successional habitat as they move between large LSRs. Riparian Reserves can serve as "stepping stones" of late-successional habitat between LSRs.

    2. Subwatershed/Site scale - Supporting persistent populations of relatively immobile species associated with late-successional and riparian habitat in order to facilitate genetic interchange between adjacent populations and to prevent isolation of populations.

- *Nutrients*- Riparian zones provide the foundation for aquatic foodwebs through the contribution of organic material. In turn, invertebrates produced in the aquatic system provide a major food source for many terrestrial animals. Additionally, the return and decay of anadromous fish carcasses provide nutrients that are subsequently stored in riparian areas.

- *Refugia*-Riparian zones provide refugia for organisms during stress and disturbance. For example, terrestrial animals utilize riparian zones for thermal regulation during winter and summer months. In the administrative sense (i.e., implementation of the NW Forest Plan), Riparian Reserves play a critical role in providing refugia for sessile and less-mobile late-successional species by maintaining a higher quality habitat conditions in relation to adjacent GFMA lands (i.e., high levels of down logs and snags) as well as serving as species source-areas for repopulating adjacent areas undergoing harvest and subsequent recovery.

How sensitive are the resource values associated with Riparian Reserves to potential hazards?

Table VI-3 summarizes the sensitivity of the identified resource value to potential hazards which may occur within the analysis area. The table evaluates the likelihood that a given resource value will experience a decrease in function in the short term (zero-to-ten years) and long term (beyond ten years) if a listed hazard occurs. It is important to note that the type and severity of hazard will effect the vulnerability and that those listed below are intended to reflect the "worst case scenario". For a detailed discussion on the effects of various management activities on riparian zones refer to Section IV.4-Riparian Habitat.

Table VI-3 Hazards to values associated with Riparian Reserves

Resource Value	Zone of Effect[1]	Associated species groups by habitat-type	Hazard	Vulnerability of Resource Value to Decrease in Function (short/long term[2])
Structural Complexity	1-5	Late-successional Riparian Lotic Lentic	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	Moderate/Moderate Low/Low Low/Low Low/Low Moderate/Moderate
Soil Moisture	2 - 5	Late-successional Riparian Seeps/Springs	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	Moderate/Low Low/Low Low/Low Low/Low High/Moderate
Microclimate	2-5	All	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	High/Moderate Moderate/Low Moderate/Moderate Moderate/Moderate High/Moderate
Plant & Animal Diversity	1-5	All	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	Moderate/Moderate Low/Low Low/Low Moderate/Low High/Moderate
LWD Recruitment-Aquatic	1 - 4	Late-successional Riparian Lotic Lentic Seeps/Springs	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/High Low/Low Low/Low Low/Low Low/Low
Down Logs	2-4	Late-successional Riparian	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/High Low/Low Low/Low Low/Low Low/Low
Sediment Regime	1 - 4	Lotic Lentic Riparian Seeps/Springs	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Low/Low High/High High/High High/High

Streambank/Slope Stability	1 & 2	All	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Moderate/Low High/Low High/Moderate High/Low
Water Temperature	1 - 3	Riparian Lotic Lentic Seeps/Springs	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Moderate/Low Low/Low Moderate/Moderate High/Moderate
Water Quantity	1-5	All	Harvest Windthrow Landslide Fire	Moderate/Low Low/Low Low/Low High/Low
Connectivity	1-5	All	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Low/Low Low/Low Moderate/Moderate High/Moderate
Nutrients	1-5	All	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Low Low/Low Low/Low Moderate/Moderate High/Low
Refugia	2-5	All	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Low/Low Moderate/Moderate Moderate/Moderate High/Moderate
Snags	3-5	Late-successional Riparian	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/High Moderate/Moderate Moderate/Moderate Low/Low Moderate/Moderate

[1]Zones of Effect:

Zone 1 - Aquatic (includes streams and seeps
Zone 2 - Stream bank (includes splash zone)
Zone 3 - Zone of riparian influence (includes area inhabited by riparian vegetation)
Zone 4 - ½ site potential tree height (approximately 90')
Zone 5 - One site potential tree height

[2]Vulnerability/Susceptibiliy is defined as the potential for the relevant resource value to experience a decrease in function as a result of the identified hazards (should they occur).

How will various management activities effect the rate or magnitude of hazards to the Riparian Reserves?

Table VI-3 discussed the relative vulnerability/susceptibility of the physical and biological values of Riparian Reserves to various hazards should they occur. Table VI-4 is an evaluation of how certain management activities may effect the *rate* or *magnitude* of those hazards if the activity is implemented. Site-scale analysis will determine a more accurate assessment of the specific impact.

Table VI-4 Evaluation of the susceptibility of various hazards to increases in rate or magnitude following a given management activity.

Management Activities (carried out under ACS requirements)	Hazard	Susceptibility of hazard to increase in rate/magnitude given management activity	
		Short Term	Long Term
Reduction in Riparian Reserve Width (Hardwood conversions and accompanying activities)	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low Low Moderate-High Low-Moderate	Low Low Low Low Low-Moderate Low
Density Management/ Commercial Thinning	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low Low Low-Moderate Low	Low Low Low Low Low-Moderate Low
Road-building and reconstruction	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow Wildfire	Moderate Low-Moderate Moderate-High Moderate-High Low-Moderate Low Low	Moderate Low Moderate Moderate Low-Moderate Low Low
Road-decommissioning	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow Wildfire	Low Low Low-Moderate Low-Moderate Low Low Low-Moderate	Low Low Low Low Low Low Low-Moderate

(continued) Management Activities (carried out under ACS requirements)	Hazard	Susceptibility of hazard to increase in rate/magnitude given management activity	
		Short Term	Long Term
Silvicultural Practices; PCT, release, fertilization, etc.	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low-Moderate Low Low Low	Low Low Low Low Low Low
Riparian Silviculture	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low-Moderate Low Low-Moderate Low Moderate-High Moderate	Low Low Low Low Low Low
Prescribed Fire	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Moderate-High Low Moderate-High Moderate Moderate-High Moderate	Low-Moderate Low Low Low Moderate Low
In-stream Projects	Landslide Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low-Moderate Low-Moderate Low Low	Low Low Low Low Low Low

Under this Level of analysis, what activities are appropriate within Riparian Reserves?

Activities which meet or do not prevent the attainment of ACS objectives may occur within Riparian Reserves. Activities such as; road decommissioning, riparian silviculture, in-stream projects, may retard attainment of ACS objectives in the short term (i.e., by increasing sedimentation or by removing riparian vegetation), however, these actions help attain ACS objectives in the long-term and are appropriate for Riparian Reserves. However, management activities listed in the previous Table VI-4 that are accompanied by moderate-to-high increases in rate or magnitude of hazards in both the short AND long term should have the appropriate hazard identified as a key issue during site-scale (NEPA) analysis.

This Level 1 evaluation sets limitations on the amount of management activities which can occur within the analysis area. Management activities which effect more than 84 acres or reduction in Riparian Reserves to less than 90 feet width will require a Level 2 Riparian Reserve Evaluation.

Are there areas where modification to the interim Riparian Reserves along intermittent

streams could occur? What are guidelines for modification?

Based on the proceeding analysis and the professional judgement of wildlife, fisheries, botany, hydrology, and soils specialists, there are opportunities to modify the interim Riparian Reserve boundaries on some intermittent streams in accordance with the Aquatic Conservation Strategy. The team recognizes that the analysis area encompasses diverse geomorphic features and habitats, and that the distributions of the species listed in Table VI-1 are not mapped for this area or completely understood. Therefore, any modifications of interim Riparian Reserve boundaries must be analyzed at the site level and tailored to the specific features and biota of the site. The final Riparian Reserve must be of sufficient width to assure protection of riparian and aquatic functions, and to maintain the integrity of the Key Watershed. To this end, the following recommendations are intended to guide the interdisciplinary team in subsequent site-level analysis and planning:

General Recommendations:

1. Riparian Reserves on areas subject to mass wasting or shallow-rapid debris flows, extremely steep soil hazard (Figure III-3), and sensitive soils including FGR1 and FGR2 (Figure III-4) should be wide enough to protect the aquatic system from landslides and sediment delivery.

2. Seeps/springs/wetlands - ensure these special habitats are included within Riparian Reserves and that the reserve widths are sufficient to maintain the characteristics of the site (e.g. shading, cool water, sediments, stable substrates, similar flow patterns/timing, maintenance of riparian vegetation, etc.).

3. Rocky habitats - when rocky habitats occur within Riparian Reserves, ensure that Reserve widths are sufficient to maintain the characteristics of the site (e.g. temperature, humidity and wind velocity).

4. Consider the habitat connectivity value of Riparian Reserves for fish and wildlife. Connectivity values include connecting adjacent drainages across ridges, providing stepping stones of late-successional habitat across the landscape, and maintaining linkages along stream reaches for terrestrial and aquatic species.

5. The following species are terrestrial and occur within the outer one-half of the interim Reserve width.   Impacts to these species will be greater through loss of habitat and changes in microclimate. Therefore, presence of the these species should be determined prior to management actions that reduce Riparian Reserve widths.

BRYOPHYTES
Kurzia makinoana
Plagiochila satoi
Racomitrium aquaticum

VII RECOMMENDATIONS

RESCISSION BILL TIMBER SALES

What immediate restoration opportunities exist concerning the two 1995 Rescissions Bill timber sales to comply with the Biological Opinion (March 18, 1997) regarding coho salmon?

According to the terms and conditions of the recent Biological Opinion between the BLM, USFS, and NMFS concerning the Southern ESU of coho salmon, newly constructed roads that remain as part of the permanent transportation system within a Key Watershed (Tier 1) should have an equivalent amount of road removed. The guidelines for road removal involve restoring the hydrologic condition of the site, which can be accomplished through a 'full' decommission procedure (refer to Western Oregon Transportation Management Plan 1996 pg.14 for details). Semi-permanent roads are to be winterized prior to wet seasons and 'fully' decommissioned within one year following activities they were built to access (including site preparation/burning).

The North Fork Chetco and Crazy 8's timber sales resulted in the construction of 2.8 miles of permanent road and 1.8 miles of semi-permanent road (refer to Appendix D, Table D-3 for road listing). In order to comply with the Biological Opinion, 2.8 miles of road needs to be removed from the transportation system. The TMO process identified 5.5 miles of road within the Key Watershed that can be fully decommissioned to meet this objective (refer to Appendix F-2 for TMO list). The additional miles over the 2.8 figure can be 'credited' towards the 'no-net increase' concerning road construction within this Key Watershed. (For list of additional roads outside the Key Watershed, see Restoration subpart, this Section)

Recommendation	miles	Road System/Area
Full decommission	4.64*	16 inventoried roads (see Appendix F-2)
Full decommission	0.83**	Morton Butte Ridge Rd.(see Appendix F-2)

* The North Fork Chetco timber sale resulted in the construction of 0.7 miles of permanent road within LSR #251. Included in the 4.64 miles of road to be fully decommissioned is 0.6 miles within LSR #251.

** The Morton Butte Ridge Road was reopened for management access earlier this decade and portions of it are currently rechanneling stream flow. This lower .8 miles is recommended for restoration to resolve this problem and the remaining portion of this road is still available to remove additional milage.

- Some roads subject to closure may be subject to reciprocal right-of-way agreements. Prior to any change in road status, consultation with South Coast Lumber Company is necessary in accordance with Instruction Memorandum OR-95-87.

What immediate restoration opportunities exist concerning the two 1995 Rescissions Bill timber sales to mitigate impacts on the LSR?

The North Fork Chetco timber sale harvested 72 acres of late-successional habitat within the LSR, 57 acres of which are also located in the North Fork Chetco <u>A</u>rea of <u>C</u>ritical <u>E</u>nvironmental

Concern (ACEC) (refer to Appendix D, Table D-3 for listing of unit acreages).

- Plant conifer within the road clearing limits, including fill slopes, of Road No. 40-13-9.0 in Section 28/33. This portion of road was reconstructed with a very wide clearing limit (50 to 80') leaving it void of trees.

- Silvicultural treatments (planting, pct, maintenance) should focus on restoring the species mix and spacing to the Rescission Act units as well as other existing plantations. Projects should encourage more conifers along streams and a lower density of conifers on hill slopes and ridgetops. See the Coos Bay District LSR Assessment for southwest Oregon for silvicultural recommendations for LSRs. The LSR Assessment, however, placed a low priority for silvicultural restoration projects in the North Fork Chetco LSR in the context of other LSRs in southwest Oregon.

KEY WATERSHED MANAGEMENT ACTIVITIES

What management activities are appropriate within the Key Watershed?
The scope of a watershed analysis defines which activities are appropriate within Key Watersheds. Those management activities addressed in Section VI-Riparian Reserve Evaluation that are suitable within Riparian Reserves (Table IV-4) are also appropriate within this Key Watershed. Regen harvest activities within the Key Watershed should be assessed in a subsequent iteration. As previously mentioned, site-scale analysis will determine the extent to which these can occur.

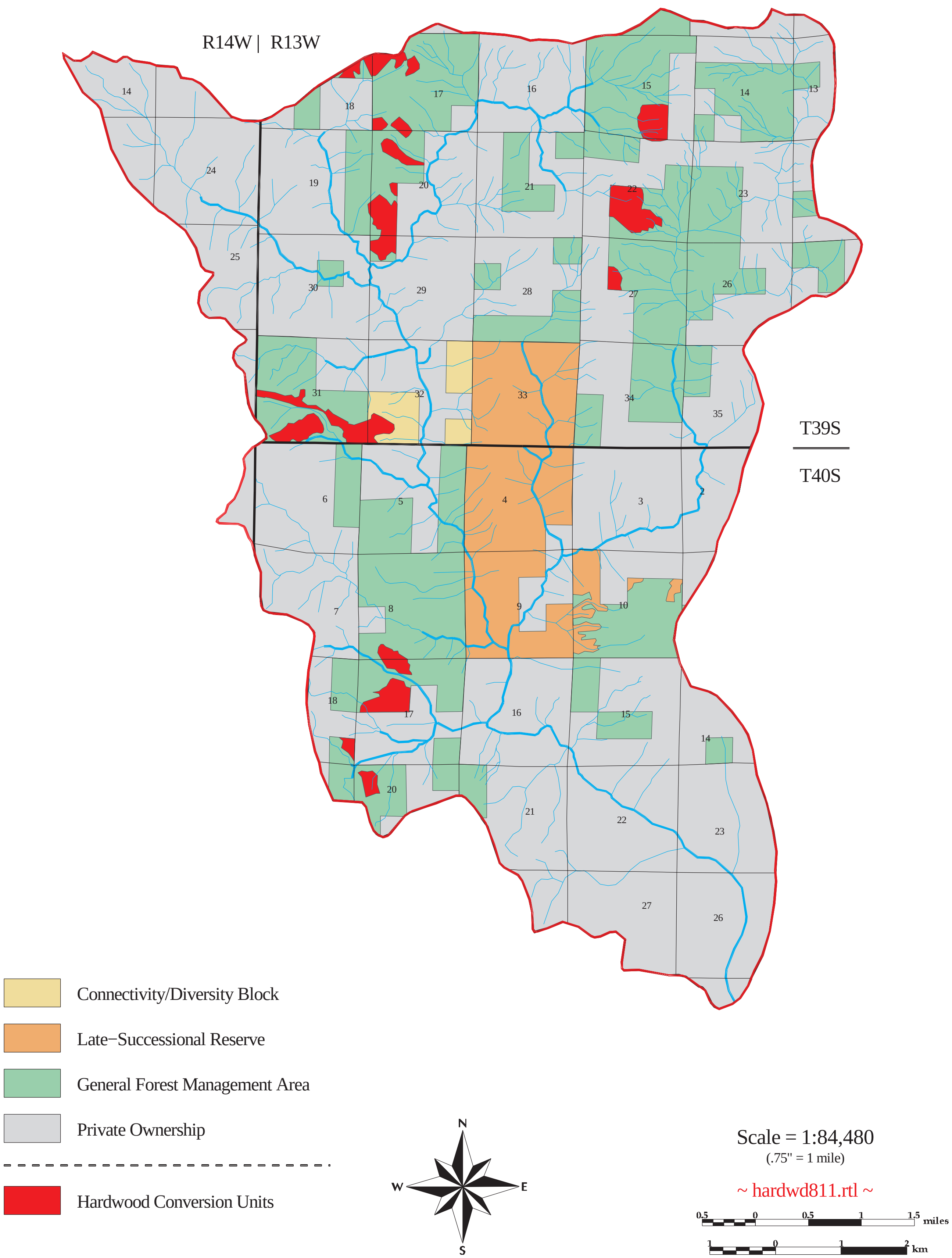
FOREST MANAGEMENT

What areas are suitable for hardwood conversion opportunities to meet the District's RMP commitment?

The first step in the selection process was the development a GIS map of all available hardwood dominated stands and brushfields. The map identified areas only within GFMA and CONN designated lands; not located within Riparian Reserve, "Withdrawn" Timber Production Capability Classification allocated lands, or other administratively withdrawn areas. These initial areas were then reviewed in the field to determine the stand stocking/composition, stand size suitable for commercial harvesting, the physical loggability, and proximity to existing roads. This step resulted in identifying 614 acres of potential conversion opportunities (Figure VII-1). Other areas may be suitable for conversion opportunities depending upon further field evaluation.

For proposed areas within the Bosley Butte and Upper Bravo hydrologic units, further analysis is required to assess the risk of elevated peak flow from the harvest in the transient snow zone.
A higher priority could be placed on conversion areas from which conifers had been removed from the stand from previous timber harvested or human-caused fires. Lower priority on hardwood stands resulting from soil limitations and natural disturbances .Detailed specifics, such as selection of logging systems, specific unit prescriptions and final unit boundaries, will be addressed through the NEPA process. In addition, project areas will require pre-project surveys for Del Norte salamanders.

Figure VII−1 Potential Hardwood Conversion Areas



RESTORATION

The following recommendations are prioritized by restoration category in order to better target which type of activity to pursue first and seek opportunities for funding. These categories were prioritized based on the following concept of; reducing erosion and sediment delivery first, removing barriers on fish bearing streams second, decreasing water temperature third, and improving aquatic, riparian, and terrestrial habitats fourth. Individual projects within each category have not been prioritized.

Erosion and sediment delivery

<u>Road culverts</u>

- The TMO process identified the following roads which contain sedimentation concerns primarily resulting from the lack of adequate drainage. Structures could be installed with the "Jobs-in-the-Woods" program or timber sales, whichever is applicable. A culvert inventory is needed to properly address the location of additional structures. Installation/ replacement of drainage structures has been identified on the following roads, but is not limited to:

Road System	Recommendation	miles
39-13-15.0	install drain dips	0.6
39-13-30.01	culvert installation	0.5
40-13- 2.0 Seg. B	culvert installation	0.5
40-13-19.0 Seg. E	culvert installation	0.3

* ‘culvert installation’ involves replacement of existing non-functioning culverts as well as installing additional culverts.

- In addition, a culvert inventory identified specific locations which contain culverts that are not functioning properly of are undersized. (refer to Appendix F-3 for specific locations and size recommendations)

Road System	Recommendation	# culverts
39-13-14.0	install drain dips	2
39-13-12.3	culvert installation	2
39-13-20.0	culvert installation	1
40-13- 5.2	culvert installation	1
1000 Road (on BLM lands)	culvert installation	4

- For the roads within the Bosley Butte area, the recommended method of resolving the drainage concern is to construct drain or rolling dips (See Appendix F-4 for design specifications). These roads are located in or close to the snow zone, are in raveling-type soils, and do not receive frequent maintenance. Under these conditions, culverts would be filled in with soil, resulting in runoff ‘diverting’ down the road surface.

- Due to the high erodibility of most all soil types within the analysis area any culvert outlet within these soils should not be ‘shotgunned’ and stream culverts should be placed on the original stream gradient. Add energy dissipaters at all outlets, unless natural ground conditions prevent erosion. Road fills over the large (i.e., 48") culverts should be armor-plated on both inlet and outlet to reduce erosion of the fill.

- Prior to construction or replacement of existing worn out or degraded culverts, stream inventories should be conducted to determine potential impacts to aquatic amphibians. Where appropriate and possible, facilitate upstream movement of aquatic amphibians through new culverts by placing culverts on or slightly below stream grade, with outlets in contact with the stream bottom. In areas where high habitat quality exists and non-jumping special status species are present, add roughening baffles to culverts to collect gravel throughout the culvert-bottoms.

Road maintenance

- Conduct annual road maintenance on the stream crossing fill near the end of Road No. 40-13-8.1 to ensure the water dips from the landing area are functional. This section is adjacent to an active rotational cut-bank slump and is a source of sedimentation into the adjacent stream. The back portion of the road can be fully decommissioned following the harvest of the residual timber.

- Construct waterdips or “flavels” on short, low traffic volume roads. Special consideration should be given to their location on highly erodible soil types or within the transient snow zone. Opportunities for such work can occur as part of timber sale final road maintenance or part of normal scheduled maintenance.

Road slumps

- Stabilize rotational cut-bank slumps on Road No. 40-13-5.2 by installing rip-rap type material at the toe of the cutbank. Use geo-tech fabric underneath to prevent moisture from coming to the surface and to add strength to the rock blanket.

Road closures

- The TMO process recommended 6 roads to be closed outside of the Key Watershed. This could be accomplished through “Jobs-in-the-Woods” programs or upcoming timber sales in the area. TMOs for individual roads are listed in see Appendix F-2. (For list of roads to be closed within the Key Watershed, see first page this Section).

Recommendation	miles	Road System/Area
Decommission/Full D’com.	1.8	Black Mound area

Cooperation with adjacent landowners

- Cooperate with South Coast Lumber Company, adjacent landowners, or through the Chetco Watershed Council to conduct road/culvert inventories which would aid in reducing sediment delivery to the stream network or identifying possible barriers to fish passage. Funding for restoration opportunities may be available through the Chetco Watershed Council or the Wyden Amendment to the “Jobs-in-the-Woods” program.

Fish passage barriers

- Remove culvert at Mayfield Creek where it crossed Road No. 40-13-5.1 (T.40 S.,R.13 W. Sec. 17 NWNW). Replace with structure that restores fish passage and maintains connectivity for all other aquatic organisms.

Water temperature (general guidelines for riparian silviculture is listed in Appendix G)

- Work with the Chetco Watershed Association, adjacent landowners, and South Coast Lumber Company to formulate strategies to reduce water temperatures along the North Fork Chetco. Listing on the 303(d) list by the Oregon Department of Environmental Quality highly recommends cooperative efforts among landowners to conduct restoration opportunities. Riparian silviculture projects to re-establish large conifers, which would eventually provide shade, would be very beneficial. These projects could also provide missing habitat features, such as large wood, and provide habitat and connectivity for riparian species.

- Explore the possibility of cooperative riparian projects among BLM, private landowners, and the Watershed Association to restore large conifers and large wood to the lower three reaches of the North Fork Chetco River.

Habitat improvement

Special Habitats

- Restore meadow habitats on BLM lands in the Morton Butte area (Sec. 6., T.40 S., R.13 W.) and upper part of Ransom Creek (Sec. 22., T.39 S., R.13 W.) in an open or early seral stage by removal of encroaching trees through control burning or cutting. Provide down log habitat along edges of meadows when possible to serve as habitat for sharptail snakes, small mammals, and other species.

- No management actions to maintain knobcone pine stands are needed at this time. Given the slow rate of growth in these stands, substantial time will pass before the encroachment of Douglas-fir will have an effect on this plant community.

Species of concern

- Restrict road widening in area where golden fleece (*Ericameria arborescens*) occurs along Bosley Butte Road.

Aquatic Habitat (general guidelines for in-stream projects is listed in Appendix G)

- Conduct aquatic habitat inventories on Cassidy Creek, Mayfield Creek, Upper North Fork Chetco River, and in other areas where inventory data is unavailable or incomplete.

- Retain all log jams and wood structure unless there is impending risk of damage to the environment or property.

- Placement of short logs and boulder weirs is not appropriate for type-C channels in the North Fork Chetco analysis area. Short logs will be easily transported, and boulder weirs would become buried in alluvial sediments.

- Woody material intercepted by roads during storm events should be incorporated back into the stream channel.

Riparian Habitat

- Conduct additional riparian surveys as necessary to develop a more comprehensive understanding of riparian plant communities, especially in fire-established tanoak stands, and in the Bravo Creek reference reach.

- Look for opportunities to use prescribed fire to treat Riparian Reserves adjacent to harvest units during site preparation burning. The use of low-intensity understory burns can be used to facilitate development of desired plant communities, modify fuel loading and continuity, and reduce the risk of catastrophic fire in riparian areas.

Terrestrial Habitat

- Create snags and down logs in areas currently deficient in these structures. In Reserve areas, manage snags for 100% cavity nester potential (refer to Section V.2 -Terrestrial Habitat) and down logs within the range of natural variability in unmanged stands (see Table V-3). Landscape scale inventories should be used to identify specific areas or landscape strata where snag and down log habitats are deficient. Reserve areas should receive the highest priority for snag and down log creation projects. See the LSR Assessment for Southwest Oregon (1997) for additional guidance on snag and down log habitat in Reserve areas.

- During pre-commercial thinning treatments, consider creating 1 small snag per acre in areas dominated by early and mid-seral stands which contain few snags.

- If necessary to cut snags for safety or other reasons, leave stumps as high as possible (5 feet or so) so they can continue to function as habitat for some bat and other species.

- The possibility of using prescribed fire to facilitate development of late-successional habitat characteristics in the LSR was assessed. Late-successional habitat is still being harvested on Matrix lands before similar habitats have a chance to develop on LSRs. This situation creates a bottleneck in the next few decades for species dependent on these habitats. Additional stand disturbance in existing mature/late-successional stands would only further restrict the bottleneck; therefore, prescribed fire projects in mature/late-successional stands in the LSR may not be prudent for the next couple decades.

MONITORING

- Separate monitoring plans (i.e., wildlife; aquatic/stream channel) which address habitat components, species, physical features, and projects have been developed or are in development. See the separate monitoring plans for further recommendations on monitoring needs.

- Monitoring stream flow along the North Fork Chetco River is planned by the construction of a gaging station at the bridge crossing the North Fork Chetco River (Road No. 40-13-25.0)

- Monitoring of individual projects will be addressed as part of the site-specific NEPA process.

DATA GAPS

- More accurate mapping of the FOI database, especially in the northeast portion of the analysis area and recent burn areas classified as ‘tanoak’ or ‘brushfield conversion’.

- Vegetation/habitat information throughout the analysis area, including field surveys to determine reference stands.

- Information specific to the North Fork Chetco is needed on precipitation intensity, stream flow, and sediment delivery (including bedload).

- Field verification on the amount of intermittent streams to more accurate calculate the Riparian Reserve acreages for the Level 1 Riparian Reserve Evaluation.

- Habitat inventory and fish distribution information on Cassidy, Upper NF Chetco, Bosley Butte, and the smaller tributaries to NF Chetco mainstem.

- Surveys to determine the distribution and relative abundance of protection buffer, Survey & Manage, and special status species.

Literature Cited:

Adams, W. T. et al. 1992. Reforestation Practices in Southwestern Oregon and Northern California. Forest Research Laboratory, Oregon State University, Corvallis.

Agee, J.K. 1991. Fire history of Douglas-fir forests in the Pacific Northwest. In L.F. Ruggiero, K.B. Aubry, A.B. Carey, M.H. Huff, techn. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. Gen. Tech. Rep. PNW-GTR-285. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. pp 25-33.

Agee, James K. 1993. *Fire Ecology of Pacific Northwest Forests*. Island Press. ISBN 1-55963-229-1.

Anderson, N.H. and J. R. Sedell. 1979. Detritus processing by macroinvertebrates in stream ecosystems. Ann. Rev. Entomol. 24:351-377.

Andrus, C.W. and H.A. Froehlich. 1992. Wind damage within streamside buffers and accelerated sedimentation. COPE Report. 5(1&2):7-9.

Atzet, T., D.L. Wheeler. 1982. Historical and ecological perspectives on fire activity in the Klamath Geological Province of the Rogue River and Siskiyou National Forests. USDA Forest Service, Pacific Northwest Region, Portland, OR. R6-Range-102-1982.

Atzet, T., et al. 1996. Field Guide to the Forested Plant Associations of Southwestern Oregon. Technical Paper R6-
NR-ECOL-TP-17-96. Forest Service, USDA, Pacific Northwest Region.

Beschta , B.L. 1996. Personnel communication.

Beschta, B.L., Bilby, R.E., Brown, G.W., Holtby, L.B., and Hofstra, T.D. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. Chapter Six In: Streamside Management, Forestry and Fishery Interactions. Edited by E.O. Salo, and T.W. Cundy. Contribution No. 57. Institute of Forest Resources. University of Washington, Seattle, Washington. pp. 191-232.

Bingham, B.B. and J.O. Sawyer Jr. 1991. Distinctive features and definitions of young, mature, and old-growth Douglas-fir/hardwood forests. In L.F. Ruggiero, K.B. Aubry, A.B. Carey, M.H. Huff, techn. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. Gen. Tech. Rep. PNW-GTR-285. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. pp 362-377.

Blaustein, A.R., J.J. Beatty, D.H. Olson, R.M. Storm. 1995. The biology of amphibians and reptiles in old-growth forests in the Pacific northwest. Gen. Tech. Rep. PNW-GTR-337. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 98 p.

Bureau of Land Management (BLM). 1972. Physical and biological stream survey. Reports on file in Myrtlewood Resource Area, Coos Bay District BLM, North Bend, Oregon, and at ODFW, Gold Beach, Oregon.

Bureau of Land Management (BLM). 1994. Port-Orford Cedar Management Guidelines, September, 1994

Bureau of Land Management (BLM) 1995. Riparian vegetation inventory conducted by M. Rodriguez and J. Colby. Data on file in the Myrtlewood Resource Area of the Coss Bay District, Bureau of Land Management, North Bend, OR.

Bureau of Land Management (BLM). 1997. Electrofishing survey for fish presence/absence, May-June, 1997. Records and reports on file in Myrtlewood Resource Area, Coos Bay District BLM, North Bend, Oregon.

Busby, P.J., Wainwright, T.C., and Waples, R.S. 1994. Status review for Klamath Mountains Province

steelhead.
U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-19. 130 pp.

Carey, A.B. 1991. The biology of arborial rodents in Douglas-fir forests. Gen. Tech. Rep. PNW-GTR-276. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific northwest Research Station. 46 p. (Huff, M.H., R.S. Holthausen, K.B. Aubry, tech. coords.; Biology and management of old-growth forests).

Christensen, M.J. 1996. Effects of Stream Restoration on Macroinvertebrate Communities in an Oregon Coast Range Stream. MS thesis, Oregon State University, Corvallis, OR.

Christy, R.E., and S.D. West. 1993. Biology of bats in Douglas-fir forests. Gen. tech. Rep. PNW-GTR-276. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 28 pp.

Cline, S.P.; A.B. Berg; H.M. Wight. 1980. Snag characteristics and dynamics in Douglas-fir forests, Western Oregon. J. Wildl. Manage. 44(4):773-786.

Cooney, C.X., and Jacobs, S.T. 1997. Oregon coastal salmon spawning surveys, 1994 and 1995. Information Reports No. 97-5. Oregon Department of Fish and Wildlife. Portland, OR. 204 pp.

Cooney, C.X., and Jacobs, S.T. 1994. Oregon coastal salmon spawning surveys, 1992. Information Reports No. 94-2. Oregon Department of Fish and Wildlife. Portland, OR. 103 pp.

deMaynadier, P.G. and M.L. Hunter, Jr. 1995. The relationship between forest management and amphibian ecology: a review of the North American literature. Environ. Rev 3:230-261.

Farnell, J.E. 1981. Curry County rivers navigability report. Division of State Lands. Salem, Oregon. 12 pp.

FEMAT. 1993. Forest ecosystem management: An ecological, economic, and social assessment. Interagency Report.

Franklin, Jerry F. and C.T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington*. Oregon State University Press.

Franklin, J.F., K. Cromack, W. Denison, and others. 1981. Ecological characteristics of old-growth Douglas-fir forests. General Technical Report, PNW-118. Pacific Northwest Forest and Range Experiment Station. 48 pgs.

Furniss, M.J., Roelofs, T.D., and C.S. Yee. 1991. Road construction and maintenance. American Fisheries Society Special Publication 19:297-323.

Geier, T.W. and D.L. Loggy. 1995. A geomorphic risk assessment of potential fish habitat impacts from forest management in southeast Alaska. USDA Forest Service, Tongass National Forest. 18p.

Goward, T. 1992. Epiphytic lichens down with the trees. In Rautio, S. Ed. Proceedings of the Symposium, Community Action for Endangered Species. Sept 1991, Vancouver B.C., Canada. pgs 153-158.

Great Gray Owl Survey Protocol. 1995. Survey protocol for the great gray owl (*Strix nebulosa*). Transmitted to the BLM in a memo dated 12 May 1995 from Regional Interagency Executive Committee Members, Californai Federal Executives.

Groot, C. and L. Margolis *eds*. Pacific Salmon Life Histories. UBC Press, Vancouver, B.C. Pp. 564.

Habeck, J.R. 1968. Forest succession in the Glacier Peak cedar-hemlock forests. Ecology, 41:872-880.

Harlow, W. M. and E. S. Harrar. 1969. Textbook of Dendrology. McGraw-Hill, New York.

Harr, R.D., R. L. Fredrickson, and J. Rothacher. 1979. Changes in streamflow following timber harvest in southwest Oregon. USDA Forest Service. Res. Pap. PNW-249; 22pp.

Harrington, T.B. and J. C. Tappeiner II. Unpublished. Growth Response of Young Douglas-fir and Tanoak 11 years after Various Levels of Hardwood Removal and Understory Suppression in Southwestern Oregon.

Healey, M.C. and F.P. Jordan. 1984. Inter- and intra-population variation in the fecundity of chinook salmon (*Oncorhynchus tshawytscha*) and its relevance to life history theory. Can. J. Fish. Aquatic Science. 41:476-483.

Huff, M.H., R.S. Holthausen, K.B. Aubry. 1992. Habitat management for red tree voles in douglas-fir forests. Gen. Tech. Rep. PNW-GTR-302. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 pp.

Hynes, H.B.N. 1970. The Ecology of Running Waters. Liverpool University Press, Liverpool. 555 pp.

Jones, J.A., and G.E.Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. American geophysical Union, Water Resources Research, vol. 32.

Konopacky, R.C. 1984. Sedimentation and productivity in a salmonid stream. Doctoral dissertation. University of Idaho, Moscow, ID.

Lisle, T.E. 1987. Overview: channel morphology and sediment transport in steepland streams. *In* Beschta, R.L., Blinn, T., Grant, G.E., Ice, G.G., and Swanson, F.J., (editors). Erosion and sedimentation in the Pacific Rim. Proceedings of the Corvallis Symposium, August, 1987. International Association of Hydrological Sciences Publication No. 165. p. 287-297.

Marcot, B.G. 1991. Snag recruitment simulator model, ver 2.52w. March 8 1991. Based on Brown (1985).

Maser C., B.R. Mate, J.F. Franklin, C.T. Dyrness. 1981. Natural history of Oregon coast mammals. USDA For. Serv. Gen. Tech. Rep. PNW-133. Pac. Northwest For. and Range Exp. Stn., Portland, OR. 496 p.

McDonald, P. M. and D. W. Huber. 1995. California's hardwood Resource: Managing for Wildlife, water, Pleasing Scenery, and Wood Products. Gen. Tech. Report PSW-GTR-154. Albany, CA: Pacific Southwest Research Station, Forest Service, USDA.

McFadden, J.T. and E.L. Cooper. 1962. An ecological comparison of six populations of brown trout (*Salmo trutta*). Transactions of the Amnerican Fisheries Society 91:53-62.

Meehan, W.R. and M.L. Murphy. 1991. Stream ecosystems. *In* Meehan, W.R. (Ed) Influences of Forest and Rangeland Management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, MD. 751.

Meinzer, O.E. 1923 Outline of ground-water hydrology, with definitions. U.S. Geological Survey Water-Supply Paper 494. 71 p.

Neimiec, S. S. , G. R. Ahrens, S. Willits, and D. E. Hibbs. 1995. Hardwoods of the Pacific Northwest. Forest Research Laboratory, Oregon State University, Corvallis. Research Contribution 8. 115p.

Neitlich, P.N. 1993. Lichen abundance and biodiversity along a chronosequence from young managed stands to ancient forest. M.S. Thesis, University of Vermont. 90 pgs.

Nicholas, J.W., and Hankin, D.G. 1988. Chinook salmon populations in Oregon coastal river basins: description of life histories and assessment of recent trends in run strengths. Information Reports No. 88-1. Oregon Department of Fish and Wildlife. Portland, OR. 359 pp.

Nickelson, T.E., Rodgers, J.D., Johnson, S.L. and M.F. Solazzi. 1992a. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon Coastal Streams. Can. J. fish. Aquat. Sci., 49:783-789.

Nickelson, T.E., M.F. Solazzi, S.L. Johnson, and J.D. Rodgers. 1992b. Effectiveness of selected stream improvement techniques to create suitable summer and winter rearing habitat for juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Can. J. Fish. Aquat. Sci., 49:790-794.

Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992c. Status of anadromous salmonids in Oregon coastal basins. ODFW Report.

NOAA. 1973. Precipitation-frequency atlas of the western United States. National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Md. 43 plates.

Nussbaum, R.A., Edmund D.B., Jr., and R.M. Storm. 1983. Amphibiams and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, ID. 332 pp.

ODEQ. 1988. 1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution. Portland, Oregon: Oregon Department of Environmental Quality.

ODEQ 1996. DEQ's 1994/1996 303(d) List of Water Quality Limited Waterbodies & Oregon's Criteria Used For Listing Waterbodies. Oregon Department of Environmental Quality, Portland, OR. 59p.

ODFW and BLM. 1995. Aquatic Habitat Inventory Project - North Fork Chetco River. Reports on file in Myrtlewood Resource Area, Coos Bay District BLM and ODFW, Corvallis, OR.

ODFW. 1997a. Personal communication with John Toman, Wildlife Biologist, Charleston, Oregon.

ODFW. 1997b. Information provided by Todd Confer, Fisheries Biologist, Gold Beach, Oregon.

Oregon Forest Industries Council. 1993. 1992 Oregon Stream Monitoring Project.

Oregon State University (OSU). 1982. Average dry-season precipitation in southwest Oregon, May through September. OSU Extension Service, EM 8226.

Oregon State University (OSU). 1993. Normal Annual Precipitation. Oregon Climate Service, 326 Strand Ag. Hall, OSU. 1 plate.

Oregon Sate Water Resources Board (OSWRB). 1963. South Coast Basin. Salem, Oregon.
Ripple, W.J. 1994. Historic spatial patterns of old forests in Western Oregon. J. Forestry. 92: 45-49.

Pearcy, W.G. 1992. Ocean ecology of North Pacific salmonids. Books in Recruitment Fishery Oceanography. Washington Sea Grant, University of Washington Press, Seattle, 179 pp.

Rosenberg, D.M. and V.H. Resh. 1993. Introduction to freshwater biomonitoring and benthic macroinvertebrates. *In* Rosenberg, D.M. and V.H. Resh (eds). Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman and Hall, New York, NY. 488 pp.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22: pages 169-199.

Sandercock, F.K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pages 395-445 in Groot C. and L. Margolis. *Pacific Salmon Life Histories*. UBC Press. Vancouver, BC.

Schoonmaker, P., and A. McKee. 1988. Species composition and diversity during secondary succession of coniferous forests in the western Cascade Mountains of Oregon. Forest Science 34:960-979.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.

Spies, T.A. and J.F. Franklin. 1991. The structure of natural young, mature, and old-growth Douglas-fir forests of Oregon and Washington. In: Wildlife and Vegetation of Unmanaged Douglas-fir Forests. Aubry, K.A. and M.H. Brookes, Eds. PNW -GTR-285. pgs. 91-109

Soule, M.E., *Ed*. 1987. Viable Population Size for Conservation. Cambridge University Press, Cambridge, U.K

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Trans. Amer. Geophys. Union. 38:913- 920.

Taylor, C.A., Melvin, W.L., Fitzpatrick, J.R., Hobbs, H.H. Jezerinac, R.F., Pflieger, W.L. and H.W. Robison. 1996. Conservation status of crayfishes of the United States and Canada. Fisheries 21(4) 25-38.

Taylor, R .L. and P .W. Adams. 1986. Red Alder Leaf Llitter and Streamwater Quality in Western Oregon. Water Resources Bull. 22(4):629-635

Teensma, P.D.A., J.T.Rienstra, M.A. Yeiter. 1991. Preliminary reconstruction and analysis of change in forest stand age classes of the Oregon Coast Range from 1850 to 1940. T/N OR-9. U.S. Bureau of Land Management., Portland, OR.

Tew, M.P. 1971. The Species Composition and Adaptations of Insects in an Intermittent Stream in Western Oregon. M.S. Thesis, Oregon State University, Corvallis, OR. 84 pp.

Thomas, J.W., Tech. ed. 1979. .Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington. Agri. handb. 553. Washington, DC: USDA, Forest Service. 512pp

Thorp, J.H. and Covich, A.P., eds. 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, CA, pp. 676-677.

Trappe, J.M. and D.L. Luoma. 1992. The ties that bind: Fungi in ecosystems. In: The Fungal Community, Carroll, G.C. and D.T. Wicklowm, Eds. Marcel Dekker, New York. pgs 17-27.

U.S. Chief of Engineers. 1893. Report. p. 3431-32.

USDA Forest Service. 1984. Preliminary Plant Associations of the Siskyou Mountain Province. Technical Coordinators: T. Aztet and D. L. Wheeler. USDA Forest Service, Pacific Northwest Region. May 1984.

US DA Forest Service. 1996a. Chetco River Watershed Analysis. Unpublished report on file at Coos Bay District, Myrtlewood Resource Area, BLM. April 24, 1996.

USDA Forest Service. 1996b. Field Guide to Plant Associations of Southwestern Oregon. Technical Coordinators: T. Aztet, D.E. White, L.A. McCrimmon, P.A. Martinez, P.R. Fong, and V.D. Randall. USDA Forest Service, Pacific Northwest Region. R6-NR-ECOL-TP-17-96.

USDA. 1997. Assessment of the Effects of the 1996 Flood on the Siuslaw National Forest. Harriet Plumley, Editor Siuslaw National Forest, April 28, 1997.

U.S. Department of Agriculture/Department of Interior (USDA/USDI). 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern Spotted Owl.

USFS. 1997. Personal communication with Angie Dillingham, Fish Biologist, Chetco Ranger District, Brookings, Oregon.

Wellman, R.E., J.M. Gordon and R .L. Moffatt. 1993. Statistical summaries of streamflow data in Oregon. USGS Open-File Report 93-63.

Welsh, H.H. Jr. and A.J. Lind. 1995. Habitat correlates of the Del Norte salamander, *Plethodon elongatus* (Caudata: Plethodontidae), in northwestern California. J. of Herpetology, Vol. 29, No. 2. pp. 198-210.

Whittaker, R.H. 1960. Vegetation of the Siskiyou Mountains, Oregon and California. Ecol. Monogr. 30:279-338.

Ziemer, Robert R. 1981. Some effects of silvicultural options on the stability of slopes. National Council Paper Industry for Air and Stream Improvement: Technical Bull. 344. 12pp.

Zika, P. 1993. *Ericameria arborescens* in Oregon. A report submitted to USDA Forest Service, Siskiyou National Forest.

Zybach, R. 1993. Native fires in the Northwest: 1788-1856, American Indians, cultural fire, and wildlife habitat. Northwest Woodl. 9(2):14-15, 30-31.